SCIENTIFIC AMERICAN

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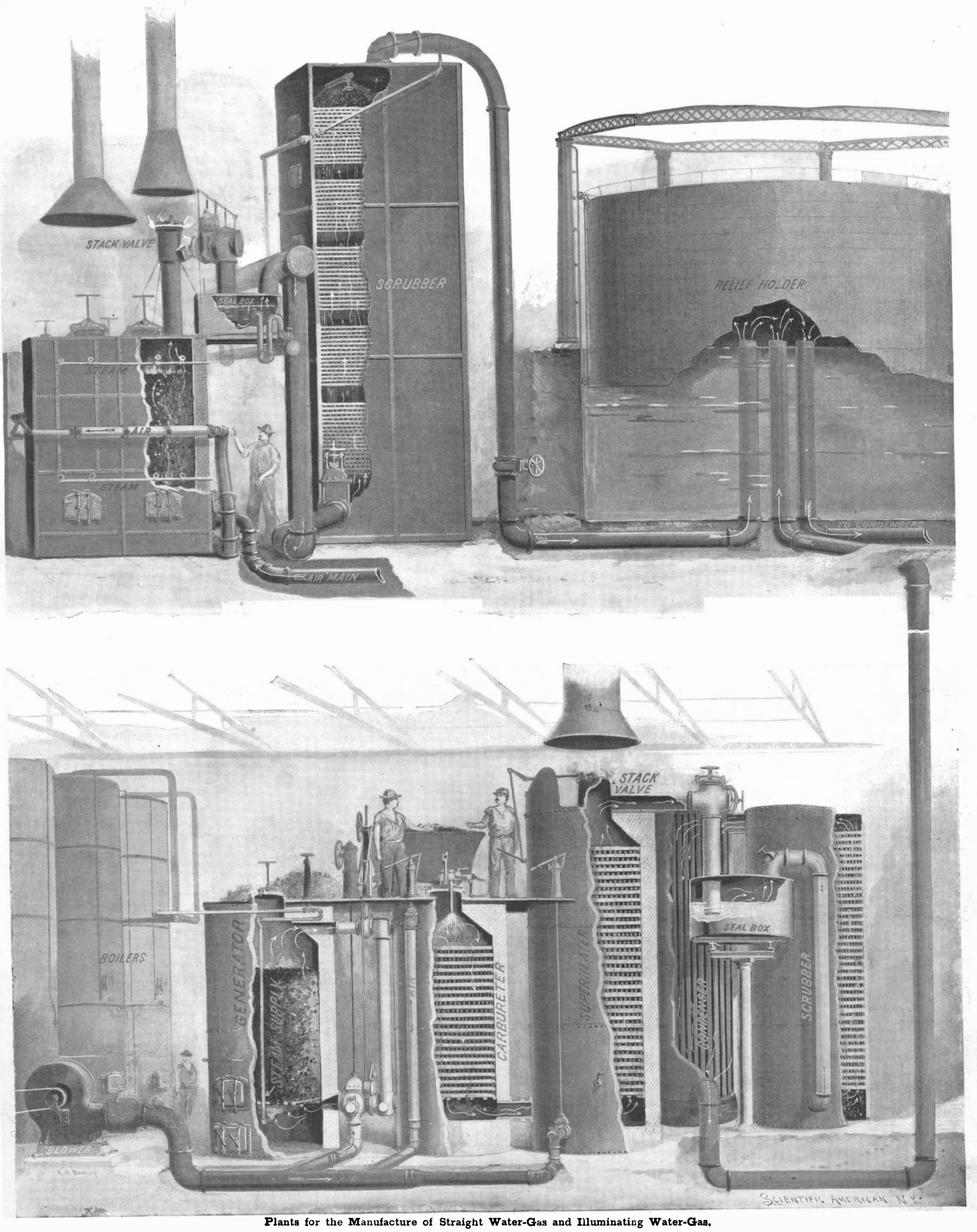

Plants for the Manufacture of Straight Water-Gas and Illuminating Water-Gas.

MANUFACTURE OF WATER-GAS. I.—[See page 39.]

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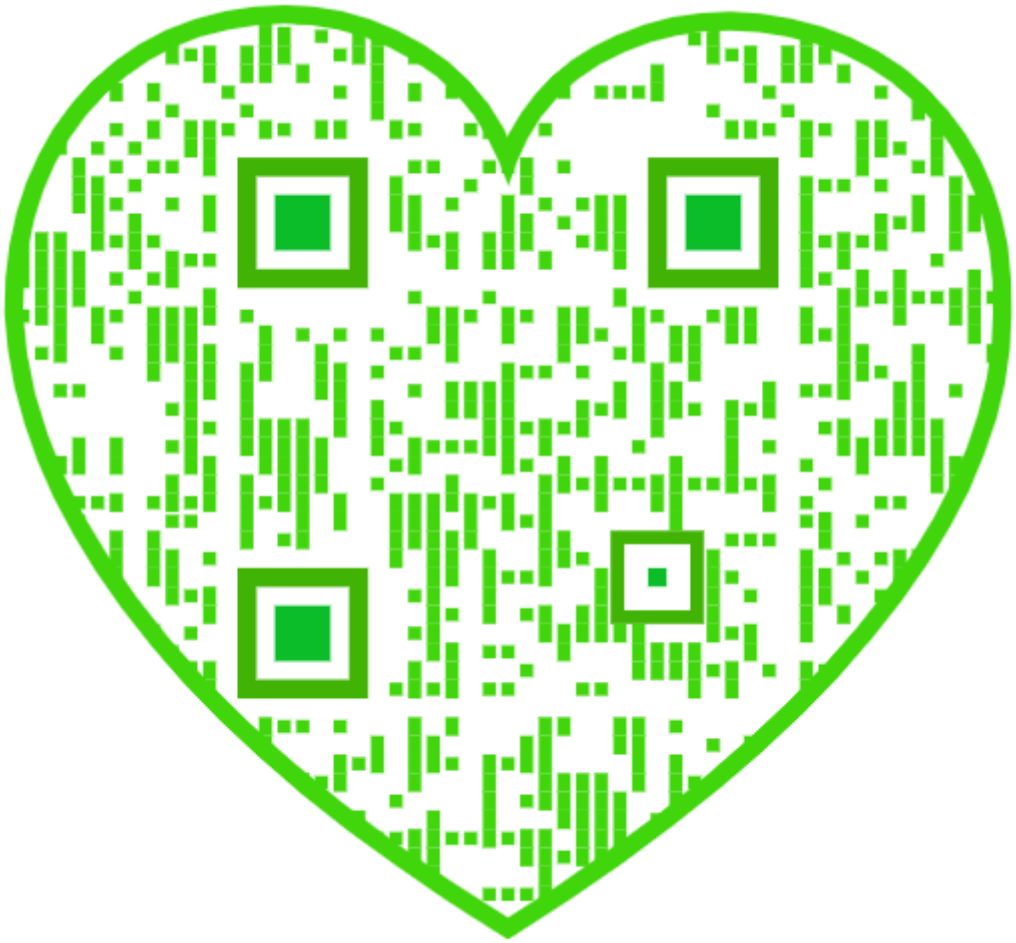

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NEW YORK, SATURDAY, JANUARY 19, 1901.

A BRAKE THAT WORKS.

The public is indebted to The Daily Mail, of London, for introducing, through its Geneva correspondent, an engineer, who is credited with an invention of a "mechanical brake" which stops a train that is running at 50 miles an hour within a distance of 20 yards. Good! But what about the passengers? A train running at the rate of 50 miles an hour covers 73 1-3 feet in a second; and to stop a train moving at this speed in 20 yards means that it must be brought to a full stop in 4-5 of a second. When we remember that, in an end-on collision, it takes several seconds for the momentum of the train to expend itself in telescoping car into car, one is moved to ask what would be the condition of the living contents of a passenger car that was brought to a stop in a fraction of the time that it takes to bring the last car of a telescoping train to rest?

WHOM THE GODS WOULD DESTROY THEY FIRST MAKE MAD.

The interference of the trades unions with the British workmen, with its consequent disastrous effect in the competitive market, has become such an old story as to render repetition unnecessary; but particular attention should be drawn to the latest testimony in this direction, which is given by Sir Hiram Maxim and relates to an occurrence in the Vickers-Maxim establishment. As related in The New York Sun, it seems that the organization had decided that a certain gun attachment should occupy a day and a quarter in the making. When the firm introduced a special machine to manufacture this piece, the men still continued to turn out only one attachment in a day and a

A German mechanic who happened to apply

rk was placed in charge of one of the machines and turned out thirteen of the attachments in a single day. Verily Whom the Gods would destroy they first make mad.

THAT MESSAGE FROM MARS.

It has been stated by an authority, whose weight will be determined by the mental attitude of his readers, that the day is near at hand when we shall be able to communicate with the other planets and preferably with Mars. It seems that in searching for a suitable location for a laboratory in which to conduct experiments in the wireless transmission of energy, Nicola Tesla found the desired conditions at a point some ten miles from Pike's Peak, at an altitude of several thousand feet above the sea. During the eight or nine months wherein Mr. Tesla was busy in the rarefied atmosphere of his laboratory, he seems to have produced some very spectacular effects; for, whereas in his New York laboratory, he was able to produce electrical discharges only 16 feet in length, and of 8,000,000 volts pressure, he here gradually "learned how to confine electrical currents of a pressure of 50,000,000 volts; how to produce electrical movements up to 110,000 horse power," and that he finally succeeded in "obtaining electrical discharges measuring from end to end 100 feet and more." Yet, in spite of his familiarity with 50,000,000-volt currents, Mr. Tesla did not disdain to study "certain feeble electrical disturbances which, by their character, unmistakably showed that they were neither of solar origin nor produced by any causes known to" him "on the globe." After deep thought upon the subject, he has finally "arrived at the conviction, amounting almost to knowledge, that they must be of planetary origin."

It would be interesting, and possibly vastly entertaining, to be supplied with the process of ratiocination by which Mr. Tesla deduces from the existence of certain puzzling electrical disturbances his "conviction, amounting almost to knowledge," that these disturbances had been launched at our particular planet from some other planet (preferably Mars), that was desirous of intercourse. Signor Marconi has suggested that these disturbances (which seem to have worked with such brilliant results upon Mr. Tesla's imagination) were due to atmospheric electricity which is especially active at such a high altitude as that of Mr. Tesla's laboratory; and Sir Norman Lockyer pertinently asks why, if electrical energy had been transmitted from Mars, it should have made its presence manifest in Colorado only; since all magnetic observatories in the world would have been simultaneously aware of it?

That some of the planets may be inhabited is possible, and there is nothing in our present knowledge of electricity absolutely to forbid the hope that in some future day we may learn how to fling forth intelligible electrical impulses into inter-planetary or even inter-stellar space; but it will certainly need something more than mere observations of some unexplained electrical impulses on a Colorado mountain to prove to a demonstration either the one proposition or the other.

CONTINENTAL CRITICISM OF THE 16-INCH GUN.

If we are to believe the artillery expert of the Krupps, and a German artillery officer who writes in a recent issue of La Revue Technique, American estimates of the extreme range of which the new 16-inch gun will be capable, are altogether too sanguine. The accepted maximum range of this weapon, as calculated by Major James M. Ingalls, the head of the Artillery School for Officers at Fort Monroe, is 20.9 miles; but the German expert denies that the gun can range further than 16 miles, while the writer in La Revue Technique claims that the maximum range of our new army gun is only about two-thirds of Major Ingalls' estimate, or from 14 to 15 miles. The latter estimate is arrived at by the "method of vertical speeds expressed as functions of the times of flight." With all due deference to these foreign criticisms, we pin our faith to Major Ingalls' estimate, for we cannot forget that, on a previous occasion, when the English artillery officers, before firing the celebrated "Jubilee" shot, invited the artillery experts of the world, including Major Ingalls, to estimate the exact range of the shell, it was found after the shot was fired that while the American expert had plotted the fall of the shot only a few hundred feet short of the actual distance, the other calculations placed the point of fall at a distance varying from 1,500 yards to some miles short. When the gun is finished, it will be interesting, as a verification of the theories of ballistics, to fire an experimental shell from this weapon, as was done with the 9.2-inch gun in England, and at a later date with the 9.45 Krupp gun at the Meppen proving ground.

THE TUNNELING CRAZE.

For some occult reason the idea of tunneling beneath straits or estuaries possesses a strong fascination for a not inconsiderable section of the public. We are all familiar with the proposed English Channel tunnel, which for half a century or more has been a favorite theme of the financial promoter; and the proposed tunneling beneath the Irish Channel has been brought persistently into prominent notice, in spite of the fact that it is manifestly doomed to failure as a financial undertaking. The latest tunnel proposal is that of a certain M. Berlier, who believes that if a double track line, 25 miles long, were carried beneath the Straits of Gibraltar, at a cost of $25,000,000, the outlay would be amply justified by the volume of traffic which would pass from continent to continent.

It is positively amusing to note the naiveté with which this gentleman assures the public that, as the depth of the sea at this point does not exceed something over a thousand feet, the construction would be perfectly feasible. Apart from the fact that from 160 feet to 180 feet is the limit beyond which it is impossible to carry on excavation under the compressed air system, a consideration which alone would prevent the construction of such a tunnel, there is the fact that the excessive grades which would be necessitated by the depth of the tunnel would render the cost of the operation abnormally high. This cost, taken with the heavy fixed charges, would render the scheme a losing venture from the very outset.

THE ENLARGEMENT OF THE WHITE HOUSE, WASHINGTON.

The American public is confronted just now with an architectural problem that calls for the exercise of rare judgment and good taste in its solution. We refer to the proposed enlargement of the Executive Mansion of the United States, which for a long period of years has been popularly and affectionately known as the White House. No architect is qualified to undertake the task of enlarging and improving this structure who is not fully alive to the historical and sentimental associations from which it takes much of its character. The building itself carries a dignity which is due to the fact that, architecturally, it is true to the period and taste of the age in which it was designed, and built; and any changes which are made, to be in perfect taste, should preserve this inherent simplicity and dignity, and carefully avoid any of the meretricious embellishments which too frequently vulgarize our modern structures. If there ever was an architectural task that called in the highest degree for the truest artistic instinct, it is this work of remodeling and enlarging the home of our Presidents. The American Institute of Architects have sounded a note of warning, to which the nation will do well to take full heed. Without casting any reflections upon the architectural designs that are turned out by the army officers who are responsible for the government buildings, we must confess that the particular plan that has been drawn up for the enlargement of the White House conforms neither in general scope, nor in detail, to the requirements of the case as we have outlined them above. There is nothing to be lost and everything to be gained by moving slowly in a matter of this importance. The capital city of the nation is not so profusely enriched with evidences of the architectural genius of this country that it can afford to add one more to the many lost opportunities, of which too many of the buildings and statuary of the city are a permanent record.

SPEED RECORDS OF THE BICYCLE FOR 1900

Although we have, many of us, lost the old-time enthusiasm in the bicycle, the really wonderful performances last year of riders who were paced by motor-cycles, are well worthy of a passing notice. From a perusal of the record table lately issued by the International Cyclists' Union, the authority of whose timings is quite unimpeachable, we gather the following facts: Although none of the records made in 1899 for a distance of a mile or under were surpassed, except that of ¾ of a mile with a flying start, all the records for distances from 1 mile up to 634 miles have been exceeded by a considerable margin, the great increase in speed in the longer distances being due to the introduction of improved motor-cycles for pacing the riders. The record of a quarter of a mile with a flying start stands, as it did in 1899, at 20 seconds and for 1 mile at 1 minute 22 2-5 seconds. Late in October of this year a rider covered, for the first time, a distance of 40 miles within the hour, the exact distance ridden being 40 miles 327 yards. Another rider, in an attempt at the twenty-four hour record, covered 183 miles in six hours, 349 miles in twelve hours and 634 miles in twenty-four hours. The speed of a quarter of a mile in 20 seconds is equal to a speed of 45 miles an hour, which is higher than the average speed, including stops, of any but a few express trains running today in this country. Such phenomenal speeds as these are rendered possible only by the pacing machine, and that they are made at all, proves that on level surfaces, the atmosphere affords by far the largest of the resistances encountered by a bicycle at speeds of over 12 to 15 miles an hour.

TRANSMITTING SIGNALS THROUGH THE SEA.

Experiments have recently been carried out by Prof. Elisha Gray, the object of which was to devise some apparatus by which the well-known power of water to transmit sound might be turned to practical account in the transmission of signals. The investigation was suggested to Prof. Gray by Mr. A. J. Mundy, of Boston, who collaborated in experiments, which have apparently culminated in a highly successful test, made on the last day of the century. This test was carried out in a vessel, which was especially furnished for the purpose with a well-hole opening directly through the center of the boat, and extending 20 feet below the sea level, in which was suspended an 800-pound bell of the kind that is used for ordinary fog signaling. Suitable mechanism was provided to enable the operator to ring the bell, making as many strokes as he might desire. It was found that at distances of a mile, or slightly more, the sound of the bell could be distinctly heard without the use of a receiving apparatus, the sound traveling through the water and passing through the sides of the ship into the hold of the vessel. An ear trumpet, the mouth of which was sealed by a tin diaphragm, was attached to the lower end of a length of gas pipe, and submerged 6 feet beneath the water, the inner end of the pipe terminating within the vessel; and with this receiver the submerged bell could be heard at a distance of 3 miles. For distances beyond this a special electrical receiver was used, the submerged part of which was connected with a common telephone receiver, installed within the ship. In a signed statement, to which were attached the names of the inventors, and of representatives of the navy and the merchant marine, it is stated that when the submerged bell was struck, the sounds were heard through the electrical receiver at distances of from 1½ to 12 miles in the open sea.

The value of this invention is readily perceived. Its first application undoubtedly would be in such dangerous localities as are now provided with the ordinary fog signal which, although it has been heard at as great a distance as 15 miles, may at times be inaudible at short ranges, because of the unfavorable con-

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dition of the atmosphere. It is proposed by Prof. Gray to station a series of submerged bells at regular intervals along the coast, which will be rung electrically from a shore station. It is claimed that a vessel provided with receiving instruments would be completely safeguarded against running ashore during foggy weather. The device may also exercise an important influence on the future of submarine warfare, for the reason that, even in the case of the ordinary torpedo boat, running at the surface, the throb of the engines may be distinctly heard with this device at a considerable distance. It is claimed, moreover, that the sounds will be even more distinct in the case of a completely submerged vessel.

SOME OF THE SINGULAR FOODS OF THE FILIPINOS.

BY GEORGE D. RICE.

Your correspondent having had the privilege of investigating the kinds of foods eaten by the native people of the Philippine Islands, some interesting information may be given concerning the way in which the Filipino makes up a good dinner at low cost. Probably the most common article of food that would not be desired by Americans or others than the Filipinos is the grasshopper. In these islands the grasshoppers not only grow in great numbers, but the size of the insect is large. There are those who make a business of catching the grasshoppers during the best season for them, which is in May, June, July and later. At first the grasshoppers begin to appear in swarms, but of small size. As the grasshopper grows the proportionate increase in size of the swarms is noticeable. At first the clouds of hoppers passing overhead seemed something like a hazy atmosphere; after a few weeks growth the clouds of hoppers become dark and heavy. They fly in large numbers, and the day is darkened as soon as swarms of hoppers appear in any vicinity. They usually light in the pastures, where they live on the smaller insects, the grass, the vegetation in general. When a swarm of full-sized grasshoppers lights on a farm or other productive land the vegetation is almost completely eaten off. In the meantime, however, the owner of the land, with all his neighbors, have been hard at work catching the grasshoppers.

The mode of catching the grasshoppers in the Philippines is interesting. There are always two or three bellboys stationed in the towers of the big church of each city, town or barrio of the Philippine group, these boys being there for the purpose of sounding the various signal bells. There are certain strokes for funerals, others for births, and at present there are signals for the approach of an army. These boys in the tower keep a sharp lookout for indications of the approach of grasshopper swarms. During the hopper season they are particularly active, and announce the approach of the swarms as soon as seen, for the grasshoppers often merely pass over a town, but usually low enough to permit the natives to catch many of them. As soon as the bellboys see that there are some scattering grasshoppers in the air, as an advance guard to the main body, they sound the hopper signals on the bells and hundreds of expert grasshopper catchers with their nets turn out.

There are several methods used by the natives for catching grasshoppers. The most effective is the net. This is a large butterfly net, arranged with netting placed over a hoop, and to the latter is fixed a long handle. The native takes this handle, and with the mouth of the net toward the grasshoppers he rushes forth, bagging considerable numbers at each run. The grasshoppers always go in swarms, except the advance guard and the stragglers, and if anything occurs to disturb their flight they get confused and tumble into bags readily or fall into the open mouths of nets. They fly so closely that they cannot well escape, as when they turn slightly out of their course they come into contact with other grasshoppers next to them.

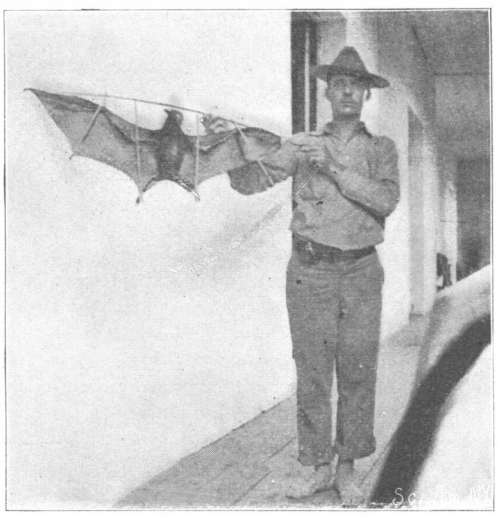
The padder method for catching the hoppers consists in using a long stick to the end of which is fixed a piece of flat wood, about ten inches in diameter. If the grasshoppers pass over one's own property, then it is safe to use this affair, for then all of the grasshoppers which are killed by swinging this instrument through the clouds of insects as they pass, are dropped to the ground, where they may be selected and picked up later on after the sun has thoroughly dried them out. Another method consists in exploding cartridges in the midst of swarms of the insects, for the shock stuns quantities of the grasshoppers, and after an effective explosion the ground is covered two or three inches deep with the grasshoppers for a distance of from twenty-five to thirty feet square.

Grasshopper catching is a profitable business in the Philippines. Grasshoppers sell at $2 per sack, gold, in the larger cities of the islands, where the people do not have a chance to get at the insects in the fields. The sacks of the islands hold about a bushel. The grasshopper is a regular article in the markets for the entire year, as after drying out the hopper can be kept indefinitely. It is in the operation of drying that the grasshopper is made eatable. I never saw a native eat a green grasshopper, but I have seen them eat the dried ones by the pocketful on the street or in company at entertainments, and by the dishful at the table at their homes. Your correspondent has tried the prepared grasshopper, and has experienced no serious results. The hopper is first so thoroughly dried out in the heat of the sun or in the bake oven that there is nothing left that is really objectionable, and a nice, crispy article of food results. This tastes sweet of itself, and something like ginger snaps. The natives usually sweeten the grasshoppers more by using a sprinkling of brown sugar. Then the confectioners make up grasshopper with sugar, chocolate trimmings and colored candies in such a way that a very nice tasting piece of confectionery is obtained.

The housewife of the Philippines takes considerable delight in placing before you a nice grasshopper pie or cake. The grasshopper pie is the most wonderful dish, as the big hoppers are prepared in such a way that they do not lose their form or any of their parts. Care is taken to keep the grasshoppers intact, and they are artistically arranged on the top crust of the pie, while on the interior are some of the broken hoppers mixed with special foods. The grasshopper cake has the grasshoppers sprinkled through it, and resembles plum or raisin cake.

In some sections of the islands the natives grind the crispy hoppers into a fine powder, and this powder is used for making articles of food, and in some places it is reduced to liquid form and taken as an article of drink.

Another article of food which is relished by the natives is procured by collecting large quantities of moths from the rocks of the mountainous regions. In several spots in the mountains in Panay and other islands of the southern portion of the Philippine group I saw moths existing so thickly in the rocky tissues that they could be scraped off into buckets by the quart. The moths seemed to mass in the crevices, and there hang. One could get a barrel of the moths



GIANT BAT OF THE PHILIPPINES.

in a very short while. The natives have not failed to investigate the worth of the moth as an article of food, and they use the insect in large quantities. Their mode of catching consists in going to the hills in parties of a dozen or more with the proper bags and articles for collecting the moths. The scraping process is used in some sections of the islands, while in Negros Isle particularly I noticed that they adopted a different scheme. Here they spread a bamboo mat on the ground beneath an overhanging colony of the moths, and then proceed to disturb the insects with the point of a spear or piece of bamboo. The little insects lose their hold and drop to the mat. They are slow of action and before they can crawl away the game is bagged.

The dainty natives will not eat the wings or the heads of the little moth, and so they now take steps to remove these objectionable parts. This operation consists in creating heat to such an extent that the tissues in the heads and wings become baked and crumble off. The natives accomplish this end by cutting holes in the earth, in which hot fires are burned until the earth is quite hot. Then the hot coals are taken away and the moths are put into the highly-heated openings. The intense heat crisps the head and wings to ashes, so that when removed from the hole and subjected to a sifting operation through netting, the powdered parts are sifted off, leaving only the body This process also does away with the legs. Often the moths in their present stage of preparation are eaten with some sugar or with other articles of food. Again the moths are used in conjunction with other mixes of food in the form of pudding and prepared dishes. The cocoanut is liberally used in mixtures with the moth and cocoanut cake and pie, and moth fillings are common. Then in some instances the moth is again baked and reduced to powder by pounding in rice pounding bowls. The powder obtained in this way is sweetened and used in various forms.

The horrible bat of the islands, which here grows in many cases to the size of the American chicken hawk, is also eaten in some sections of the Philippines. The best classes of natives, however, do not eat the bats The mode of catching the bats is peculiar. The cities towns and barrios of all of the islands of the Philippine group are quite overrun with bats, which fly through the streets at night in large numbers. They fly slowly and seem incapable of dodging articles in their path. Therefore, the native takes a long pole, puts a sort of combination hooked arrangement at the top and takes position in a street, and with the pole held erect waits for bats to come along and bump into the hooked portion. As the native sees a bat coming he plans to have the hook in its path, and as he moves the pole, so as to bring the hook into contact with the head of the bat, the later usually strikes it with a bang and drops to the earth stunned, when the native proceeds to promptly put the bat to death. After standing in his position for an hour or more, the native has a little pile of bats at his feet. These he takes to the market the next day and receives about two cents each for them. The bats are eaten only in small part. The wings, head, and, in fact, all but a small portion of each side is thrown to waste.

Iloilo, Isle de Panay.

SCIENCE NOTES.

Sixteen hundred persons in the crowds which assembled in London on the return of the volunteers from South Africa received injuries which required medical attendance.

A magnificent marble sarcophagus has been unearthed at the village of Anhar, which is situated near the site of the ancient town of Iconium. The tomb is freely sculptured with flowers, animals and figures of exquisite workmanship, and is stated to be far superior to another similar one at present treasured in the Stamboul Museum. The period to which it belongs has not yet been determined. It weighs nearly thirty tons, and is to be conveyed to Stamboul as soon as suitable transportation facilities have been organized.

The establishment of a royal mint in Canada will make the fourth branch of the English mint in operation outside London. The other three ramifications are located in Australia, at Melbourne, Sydney and Perth respectively. According to recently published returns, the value of the gold coin output from these four mints during 1899 was as follows: The Royal Mint, London, $42,601,555; Melbourne, $28,138,835; Sydney, $16,620,000; Perth, $3,458,530. It has also been mooted that the government proposes ultimately to establish another branch in the Transvaal.

The solution of the sugar bounties problem which has been such an acute question among certain of the European powers for some time past appears to be in sight. It is stated that as a result of the negotiations between France, Austria and Germany, the two latter countries will renounce their bounties if France, whose bounties are greater, will consent to a commensurate decrease. Further negotiations will be suspended until England consents to give up all compensating taxes, in which event the conference will resume its work at Brussels, in order to formulate a scheme to control internationally the sugar tariffs.

The prizes in connection with long distance ballooning in Paris have recently been awarded by the Aerostatic Society. Comte Henri de Vaulx was awarded the grand prix for his two lengthy excursions into Poland and Russia respectively, while he also carried off the gold medal for record ballooning. The second prize was secured by M. Balsan, who followed very closely behind the first prize winner, while he also secured the silver clasp. The competition was adjudged carefully by a number of aeronautical specialists, including Major Bourgeois, an expert from the War Office, and the distances were rigorously calculated.

At the Anthropological Institute in London Prof. E. B. Tylor recently lectured upon the existing native race in Tasmania, and formulated evidence for the purpose of showing that it represents a period contemporaneous to the stone age, but below even that of pre-historic man in Europe, at the period of the mammoth. He stated that the natives are contemporary with the lowest available record, but they possess the arts of house and boat building, fire making and cookery, basket and leather work, rude tools, and weapons, combined with a mythology including star myths and nature spirits—an animistic religion culminating in polytheism. Prof. Tylor considers from the results of his investigations and study of the race that the Tasmanians present a picture of man's life on earth which, although not primitive, is probably the earliest that is based on direct anthropological evidence.

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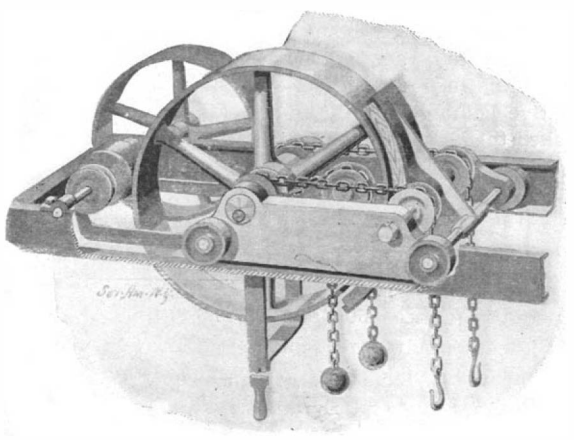
AN OVERHEAD HOISTING AND CARRYING DEVICE.

Our illustration pictures a novel overhead hoisting and carrying device, invented by Norman E. Brown, St. Joseph, Mich., which quickly raises a load, locks it in position, and then transfers it overhead to its destination.

The entire device is mounted on a carriage which travels on overhead tracks. In the carriage a shaft is journaled which carries a friction-wheel at its center, two sprockets placed one at each side of the friction-wheel, and eccentrically-mounted disks attached to a controlling lever. The friction-wheel can be moved into engagement with a driving-pulley secured on a driving-shaft driven by a belt. In order to lock the friction-wheel and driving-pulley together, spools are provided, which rotate loosely on the driving-shaft, and which are gripped by the inclined ends of arms projecting from the controlling-lever. About the sprocket-wheels carried on the shaft of the friction-



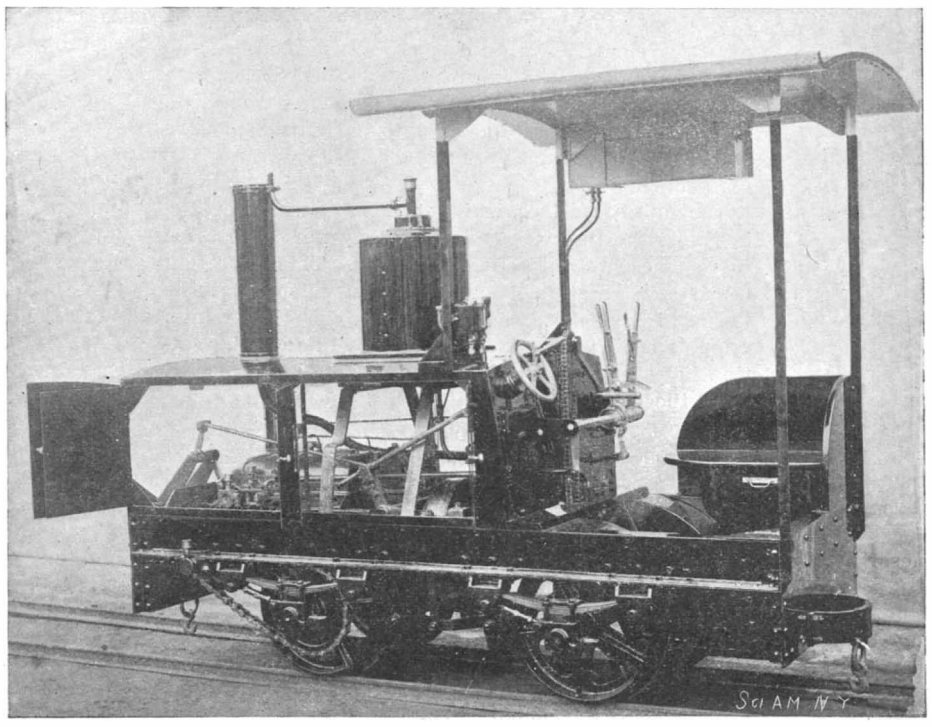
OVERHEAD TRAVELING HOISTING DEVICE

wheel, hoisting-chains pass, which extend over guide-pulleys.

By swinging the controlling-lever in a vertical position, the friction-wheel and driving-pulley are locked together, so that the movement of the one is communicated to the other. When the load has been hoisted, the lever is thrown to the right to turn the eccentrically-mounted disks and move the friction-wheel out of engagement with the driving pulley and into engagement with a brake-shoe on the carriage. The friction-wheel is thus prevented from rotating, so that the carriage and its suspended load can be moved along the tracks to the desired place. By means of the lever the wheel can be gradually released, so as to drop the load slowly.

PANHARD & LEVASSOR PETROLEUM LOCOMOTIVE.

The Panhard & Levassor Company, the Paris automobile constructors, have recently brought out a type of small locomotive with petroleum motor, whose general appearance is shown in the engraving. It is provided with a motor of five horse power, and is designed especially for use in shops or between the different buildings of large establishments. It is particularly adapted for the cases where the running of the locomotive is intermittent, as it is arranged to start and stop almost instantly by a simple device. The working parts of the locomotive are a combination of the same elements which enter into the construction of a petroleum automobile. The motor is of the same type as that used in the large Panhard & Levassor machines, and works by gasoline at 700 degrees density, using a carbureter at constant level; the ignition is obtained by platinum tubes maintained at a red heat by burners under pressure. A governor keeps the motor speed constant at 750 revolutions by closing the exhaust valves when the speed rises above this limit. A fly-wheel of 90 pounds is used with the motor. Movement is communicated to the front wheels by a set of speed-changing gears of the same type as used in the heavy automobiles. The motor is connected to the gears by a friction-cone of leather upon cast iron. As this mechanism is the same as for automobile wagons making at least four miles an hour, an additional set of gears is used between the first set and the pinion carrying the chain, in order to further reduce the speed. The chain passes to a wheel on the front axle, as will be noticed. Upon the rear platform are grouped the various levers for starting, speed-changing, etc., and the brake-levers, the arrangement resembling that of an ordinary locomotive; the idea is also carried out in the external arrangement. This type of locomotive will draw a load of about three tons.



PANHARD & LEVASSOR PETROLEUM LOCOMOTIVE.

A New Rifle Sighting Device.

A very ingenious additional aid for sighting rifles has been devised by Mr. W. Youlten, of England. It is called the infrascope, and by its utilization a soldier can sight his rifle to fire at a certain object, although the target itself may not be within his actual range of vision. The apparatus consists of a small metal tube about 12 inches in length and about an inch square. At each end is placed a small reflector, somewhat similar to the view-finder of a hand camera, inclined at an angle of 45 deg. The soldier fixes the instrument to a collapsible extension stock, attached to the butt of his rifle, and the breech of the firearm is brought to the level of the top of his helmet. The soldier, instead of securing his aim by means of the rifle sights, simply looks into the lower mirror of the infrascope, upon which is reproduced the reflection of the image in the upper mirror. The sight line of his rifle is also reflected upon this little mirror. The soldier, in firing, discharges his rifle, as it were, at the object in the mirror. The instrument is so perfectly adjusted that experiments have conclusively proved that the aiming capacity of the soldier is considerably improved by its co-operation. The British War Office has submitted the invention to a series of tests, and the report is so favorable to the device that there appears every possibility of the infrascope being attached to the small arm of the British army in the near future. It has been tested in the South African war with conspicuous success. In this case the instrument was utilized for scouting purposes, for which work it is specially adapted, since one can secure safe hiding and yet follow any movements in the surrounding neighborhood by the manipulation of the apparatus. It has also been developed for employment with the quick-firing machine guns and the heavier artillery.

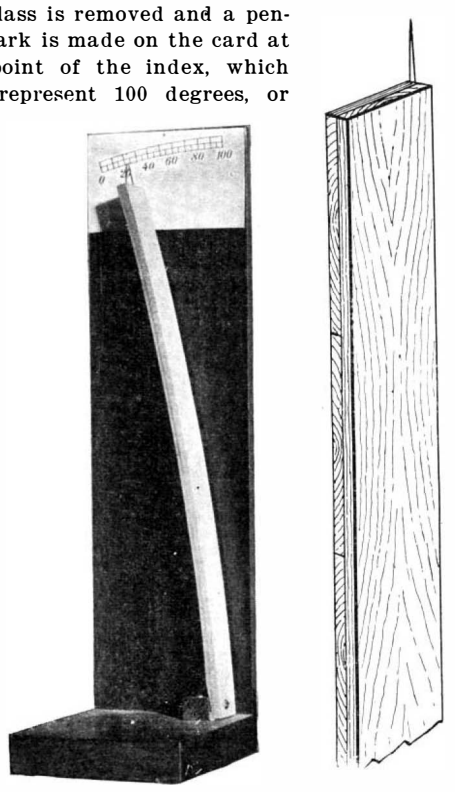
VII. SIMPLE HYGROSCOPE.

BY GEORGE M. HOPKINS.

No instrument is required to indicate a superabundance of humidity in the air. Everyone knows the discomforts of a moist, hot day in the summer without requiring a hygroscope. Still, to one scientifically inclined it is some satisfaction to know the hygrometric state of the air, and to compare one day with another of the same year or previous years.

A very simple hygroscope which is accurate enough for all practical purposes is illustrated by the engraving. Its construction was suggested by a panel made of two pieces of wood glued crosswise to keep it straight—the very best arrangement of the grain for causing it to assume a concavo-convex form under all conditions of the atmosphere except that in which it was glued together. It has a baseboard 4 inches square and 7/8 inch thick, with a back piece 4 inches wide and 13 inches high and 1/4 inch thick, attached to one edge. Near the right-hand edge of the base is secured a block to which is attached a hygroscopic strip made up of a longitudinal piece of any elastic wood (such as whitewood) 12 inches long, 1 inch wide and 1-16 inch thick, and a transverse piece of whitewood of the same thickness 1 inch long and 12 inches wide, carefully glued to it, so that the grain of one strip is at right angles to that of the other. These strips of wood should be well seasoned. This compound strip is secured to the small block on the base of the instrument, and a piece of plain cardboard is attached by two tacks to the wooden back at the center of the board, leaving the ends of the card free. The concave side of the strip should be arranged to face the left-hand side of the instrument, and a short piece of small wire, say No. 24, or a headless pin should be inserted point outward in the free end of the strip to serve as an index.

The scale is constructed by first placing the instrument under a bell glass with several pieces of wet blotting paper near but not touching the strip. The long, narrow strip does not change its length, but is bent one way or the other by the swelling or shrinking of the piece which is glued crosswise. The hygroscopic strip will straighten out or even curve in the opposite direction when submitted to the influence of moisture, and after the lapse of six or eight hours the glass is removed and a pencil mark is made on the card at the point of the index, which will represent 100 degrees, or



HYGROSCOPE. HYGROSCOPE STRIP.

the point of saturation. The instrument is allowed to assume the normal position by drying it in the open air, after which it is again placed under the bell glass with a dish of calcium chloride and allowed to remain five or six hours. The calcium chloride removes the moisture and causes the cross-grained side to shrink and thus curve the strip considerably. It now indicates the maximum dryness of the air, and a mark is made at the point of the index, indicating zero. The spaces between zero and saturation should now be divided into ten equal spaces, and each space may be subdivided into ten spaces, each representing one degree.

These lines should be neatly made with a drawing pen. Every tenth graduation should be extended a little and numbered; the entire scale being numbered from 0 to 100, i. e., 0, 10, 20, 40, etc.

This instrument is not intended to accurately show the exact amount of moisture, as is the case with the more elaborate hygrometers, but to afford a simple means of showing the ever-varying state of the air.

New Method of Bleaching.

The United States Consul at Coburg calls attention, in a recent report to his government, to Prof. Koechlin's method for the bleaching of cotton and other vegetable fibers by passing them through a bath of 100 liters (26 gallons) of water; 10 kilogrammes (22 pounds) of lime, and 50 kilogrammes (110 pounds) of bisulphite of soda. They are then steamed for an hour or two under a pressure of from one to two atmospheres, rinsed again and dried. The bisulphite can be replaced by hydrosulphite of lime. The cotton or other fiber may be boiled in the bath for a few hours instead of being steamed. Another process is to subject the goods for six hours under a pressure of two-thirds of an atmosphere to a liquid composed of 1,000 liters (264 gallons) of water, 10 kilogrammes of dry, caustic soda, 10 kilogrammes of soap, 1 kilogramme (2.2 pounds) of calcined magnesia, and 30 liters (7.9 gallons) of peroxide of hydrogen; the goods are then rinsed, soused, rinsed again and dried. The white obtained is said to be much better than could be had with hypochlorite, and the process is stated to do no damage to the fibers or fabric.

GOLD has been discovered near Apia, Samoa.

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THE RAPID TRANSIT TUNNEL.

Work on some sections of the Rapid Transit tunnel is so advanced that it is now possible to get a good idea of the appearance of the inside of the tunnel as it will look when completed. The accompanying photographs were taken on Broadway at 135th Street, at the point where the long viaduct, by which the tracks will be carried across the Manhattan Valley, intersects the northern slope. The subway at this point has been built in an open excavation, and our illustrations were taken when the steel bents had been placed in position and before they had been walled in with a covering of concrete.

The whole of the subway and tunnel construction is to be of absolutely waterproof construction, and some description of this waterproofing and of the concrete filling will be of interest. The floor consists of a layer of concrete which varies in thickness, being 8 inches upon rock, and thicker when it is laid upon a loose or moist formation. Above the 8 inches of concrete is spread a layer of waterproof material, which is put down in the following manner: After the 8 inches of concrete has been carefully smoothed off, a layer of hot asphalt is spread upon it, and upon this is rolled down a sheeting of felt. Then follows another layer of asphalt and felt, the layers varying from two to six, according to the dampness and general characteristics of the surrounding material. Above the waterproofing is another layer of concrete, in which are laid the tracks and the stone or concrete footings for the columns and I-beams which support the roof and sides of the tunnel. The steel framework, as shown in the engraving, is made up of transverse bents, consisting of built-up columns, spaced 5 feet apart longitudinally and 12 feet 6 inches apart measured in the direction of the tunnel. The top member of each bent is a heavy I-beam. The wall posts also consist of I-beams, and angle iron knee-braces are riveted at the upper angles formed by the junction of the center and side columns with the roof to give lateral stiffness to the whole framework. The spaces between the I-beams of both the wall and the roof are filled in with concrete, which is smoothed off flush with the outer flanges of the metal. Immediately upon the flanges and the outer surfaces of the concrete filling as thus finished off is placed a complete layer of asphalt and felt waterproofing similar to that used in the floor as above described. After the felt has been put in place an outer layer of concrete whose thickness is determined by the nature of the excavation is carefully rammed in place. The subway as thus finished is inclosed in a waterproof envelope, which extends entirely around it.

The two interior views of the subway which we present are taken at the point where the masonry viaduct which forms the abutment of the steel viaduct across Manhattan Valley commences. This viaduct, which will be located about a thousand feet east of the Riverside Drive viaduct, will consist generally of plate girders carried upon braced towers, except across Manhattan Street, which will be spanned by a single elliptical arch of handsome design.

The engineers and the majority of the contractors of the Rapid Transit Commission are to be congratulated upon the progress which is being made. With a few exceptions, such as the section along Forty-second Street, the work has been opened up from Duane Street to 181st Street on every mile of the route, and for long stretches the excavation is practically continuous. In several sections the steelwork is in course of erection, and the concreting is keeping pace with it. The two deep shafts at 167th and 181st Streets are down to grade, and the drifts are being pushed forward. Steel is on the ground in sufficient quantities to keep the erecting gangs busy; and altogether the prospects of completing the tunnel on contract time are promising.

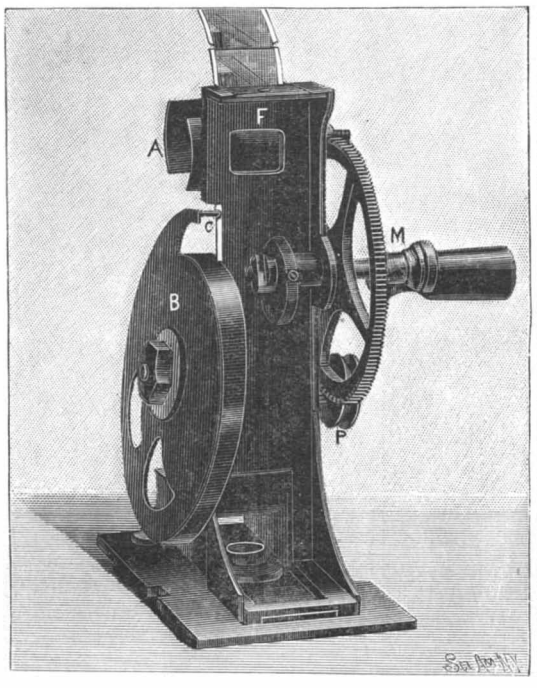


Fig. 1.—THE MIROGRAPH ACTUATING AND OBTURATING MECHANISM.

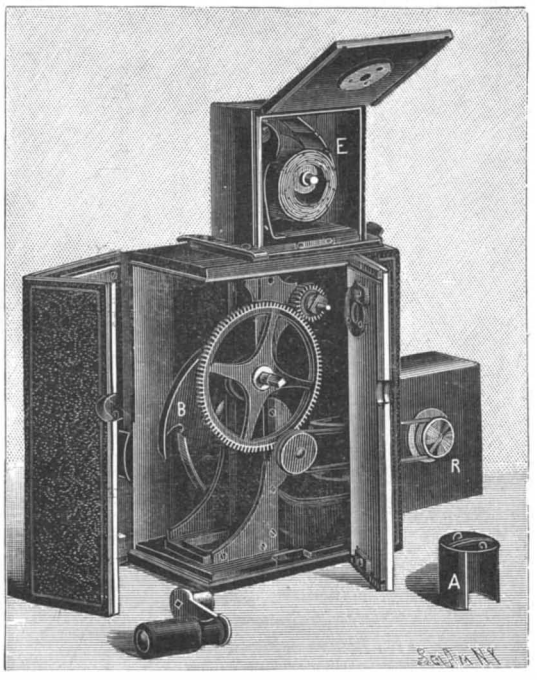
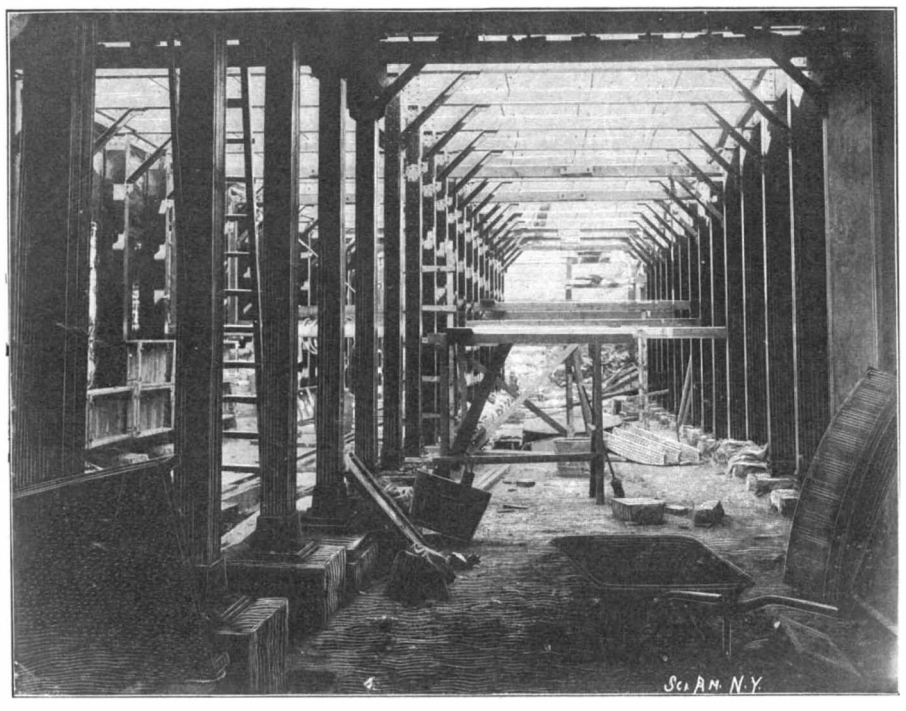


Fig. 2.—THE MIROGRAPH ARRANGED FOR TAKING A PHOTOGRAPHIC NEGATIVE.

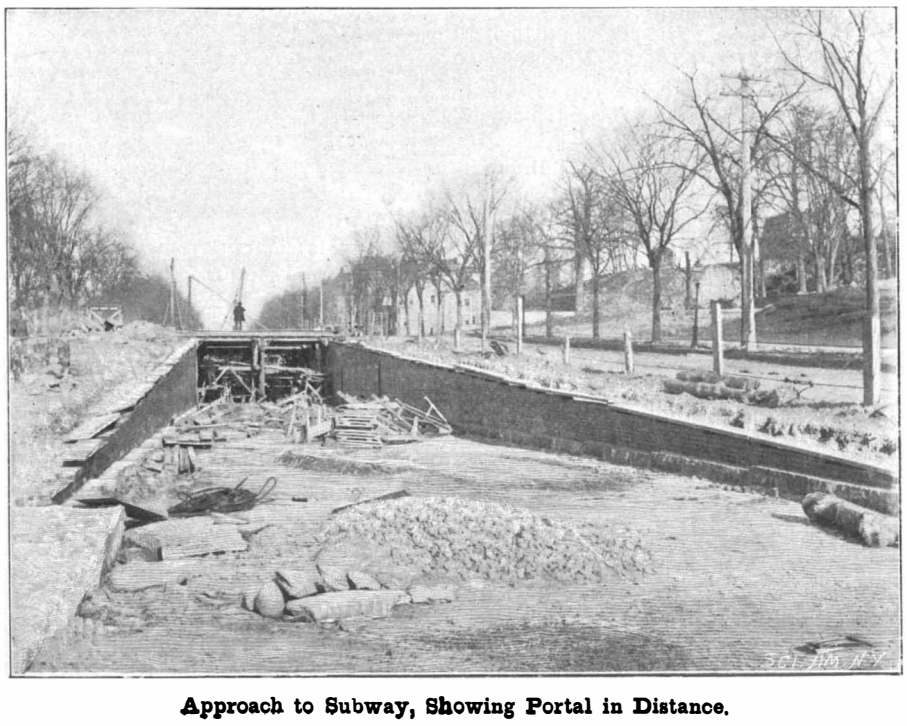
THE MIROGRAPH.

It would require a volume to set forth all the solutions that have been proposed for the problem of intermittently actuating the films of cinematographs. None of the devices invented, we think, is simpler than the "Mirograph" of MM. Reulos and Goudeau. The actuating mechanism, according to La Nature, consists of a disk, *B* (Fig. 1), the circumference of which is provided with a flange, *C*, at right angles with it. This disk is mounted on a central horizontal shaft driven by a crank, *M*. The flange, *C*, is not completely circular. For three-quarters of the circumference every point is equally distant from the shaft. After the three-quarter point the flange gradually approaches the center. From this arrangement it follows that the two ends do not meet, but are located on the same diameter, about 0.01 of a meter apart (Fig. 2). This is what constitutes the principle of the invention. The film is not perforated, but is provided with notches on each side at the level of the line of separation of the images, which notches are engaged by the flange, *C*, of the disk. The film will remain immovable as long as a notch is in engagement with the circular part, but when the eccentric part is brought into action a forward movement will result equal to 0.01 of a meter; that is to say, to the width of the image. The film having moved forward through this distance, the notch escapes the eccentric extremity, but the other extremity immediately engages the following notch. Then, as the disk continues to rotate, the film is intermittently fed along.

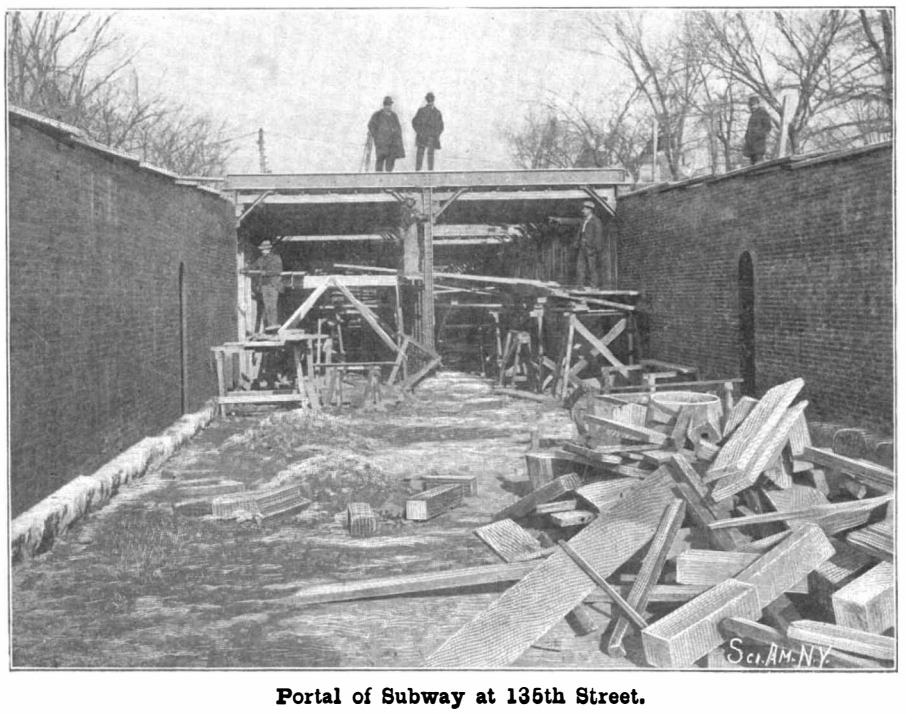
The rotary motion is not given directly to the disk, *B*, but through the medium of gearing connecting the crank and the disk-shaft (Fig. 2). The gearing comprises a spur-wheel engaging two pinions, the lowermost of which is keyed upon the shaft of the disk, *B*, and the uppermost of which carries the shutter. The shutter, *A* (Fig. 2), consists simply of a tube having cutaway portions situated opposite each other. The shutter is placed horizontally (Fig. 1) against the opening, *F*, behind which the film passes. In its revolution the shutter presents its closed and open part alternately. The size of the pinions is such that the open part of the shutter presents itself opposite the opening during the inoperative position of the



Interior View, Showing Steel Framing Before Concreting.



Approach to Subway, Showing Portal in Distance.



Portal of Subway at 135th Street.

PROGRESS OF THE NEW YORK RAPID TRANSIT TUNNEL.

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film. This mechanism, which is but 5 inches in height, 4 inches in length, and 2 inches in width, is mounted upon a metallic plate which can be employed in different apparatus for taking a negative, for looking at the image directly, or for projecting an image in a highly magnified form.

The arrangement for making negatives consists of a box which may be hermetically closed (Fig. 2). Upon one of the sides the objective is fixed at such a height that a sharp image may be formed at the opening, *F*, behind which the film passes. The shutter is placed between the objective and the film. The sensitized film, which is 20 feet in length and ¾ of an inch in width, is placed in a box, *E*. Two slots are provided for the passage of the extremity of the film, which is secured to the actuating mechanism and to the shaft of a pulley carried by a second box, *R*, fixed near the bottom of the apparatus. A small belt connects this pulley with the actuating mechanism and facilitates the winding up of the part that has been exposed. For printing the positives, the same arrangement is used, with the difference that the negative and an unexposed film are brought in contact with each other. If it be desired to examine a positive film without the necessity of making a projection, the mechanism is taken from the photographic apparatus and placed in the microscope. This is a wooden box, upon which is mounted an optical arrangement that brings the line of sight opposite the opening, *F*. The film is wound up at the upper part, and in unwinding causes the images, slightly magnified, to pass under the eyes of the observer.

For projection, the mechanism is arranged in front of the condenser lens of an ordinary lantern, and an objective of wide aperture is placed on the other side in a special mounting. The shutter used in making the negative is removed, and in its stead a shutter having a larger aperture is used. Owing to the wide aperture of this shutter, the image is lighted for a comparatively long time, and with a four-wick kerosene projection lamp of the ordinary type a fairly bright image one meter square is obtained. If an oxyhydrogen or electric light be used, it is possible to obtain large dimensions. In all cases the image obtained is very steady. The Mirograph is essentially an apparatus for the amateur.

New Railroad Lines in the Caucasus.

The Committee of Public Works, which is under the direction of the Minister of Transports, has authorized the construction of three new railroad lines in the Caucasus region, of which a description has been recently given in the Torgovo-Promychlenaia Gazeta, one of the Russian official organs. The shores of the Black Sea, an agricultural and mining region, have scarcely any roads, and, on the other hand, but little transportation is carried on by boat, owing doubtless to the poor arrangements of the ports and the violence of the tempests which occur on the Black Sea, which is very deep in these regions. At present a road is in construction, but the Russian government, judging this to be insufficient, has decided upon the construction of a line of railroad uniting the port of Novorossiysk to the Transcaucasian railroad. The line will start from a point between the stations of Dinskaia and Stanitchnaia, on the Vladicaucasus railway, passing by the stations of Bjedoukovsk and Tchernigoff; it will traverse the Caucasus range by the Maikope route and will pass along the coast as far as Soukhoume-Kalé, which at present will be the final station.

The total length of the railroad will be about 28 miles. There is besides a project for a prolongation of the line from the last-named station to that of Novo-Senaki, on the Transcaucasian, a distance of 80 miles. This route will shorten by 450 miles the distance between Tiflis (the capital of the Caucasus district) and Rostoff, on the river Don, the port of the Azof. The line, which is of standard gage, will besides supply the coal mines of Tkvartchelsk, which belong to the government. For this line a company is to be formed with a capital of $13,000,000. The second project is that of the Kakhetie railroad, which is to have a length of 110 miles and will pass through the wine-growing regions of Tsimondal and Kakhetie. It will start from a point near Tiflis and pass through several towns, ending at the village of Sakobo; it may possibly be continued to the station of Evlakh, on the Transcaucasian. An annual traffic of 190,000 tons is expected.

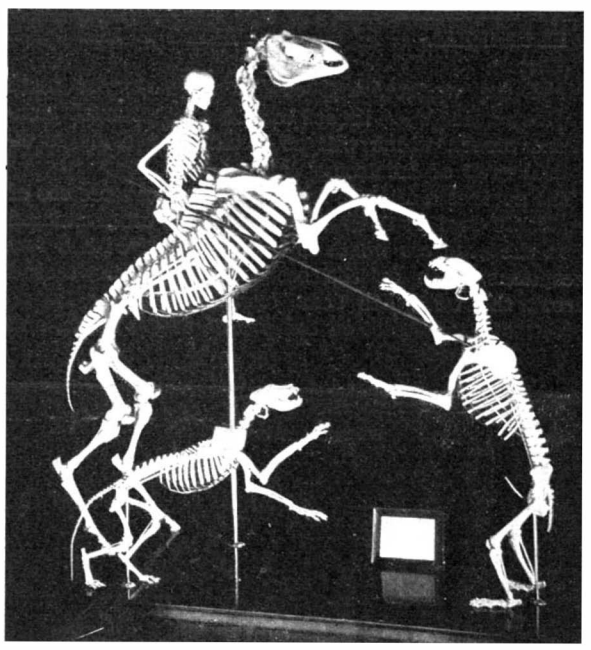
The total cost of the line, including rolling stock, is estimated at over four millions, which the promoters of the project, Prince Tchavtchavadjé and the engineer, Simberg, expect to realize by an issue of shares. The third project concerns a railroad which will supply the mines of Sadonsk and the metallurgical works of Alaguir, in the northern Caucasus. It will traverse the military regions of the Cossacks of the Terek, inhabited also by the tribe of the Ossetines. Starting from the Vladicaucasus line, the new railroad will pass the gorges of Ardone, through a flat agricultural region formed of a fertile black earth, then crosses the river Argone and passes through an important forest region, situated at the foot of mountains, which are very rich in argentiferous lead ores, copper, and especially zinc ores. Up to the present, the bad state of the roads did not permit an active working of the Allaguir mines, conceded by the government to a company of the same name. These mines are, however, very rich, and it is estimated that they contain 1,640,000 tons of argentiferous lead and 6,500,000 tons of zinc ores.

To Recognize Erased Writing.

In examining hand-writing, Comphuis, army-apothecary at Malang, Dutch East India, succeeded in making erased letters reappear by means of silver nitrate solution. Where an erasure was suspected, a one-tenth normal silver nitrate solution was applied and exposed to direct sunlight for a short time. The letters appeared on the resulting black back-ground. The cause is probably ingredients contained in the ink, which retard the reduction. In the reducing of the silver nitrate solution, impressions of the hands, etc., were also plainly visible.—Pharmaceutische Centralhalle.

AN INTERESTING GROUP.

This group represents a fight between a mounted Indian and his dog and a grizzly bear. It was arranged by Mr. Charles H. Ward, of Rochester, N. Y., who secured the skeletons and mounted them in positions which the man and animals would assume in a contest at close quarters. The bear reared upon his hindpaws and prepared to strike down the horse with his forepaws, while the dog is in the act of springing upon him. The Indian has charged with his spear,



A SKELETON COMBAT GROUPED BY C. H. WARD.

which is pointed at a vital part of the bear. This is believed to be the first bear hunt in bones ever arranged.

One of His Educators.

This is the time of the year when the editor's heart is gladdened by frequent manifestations of what might be termed the personal side of the relations between himself and his readers; who frequently avail themselves of the opportunity offered by the renewal of the year's subscription, to insert a few sentences appreciative of the Scientific American, or a significant statement of the lengthy term of years during which they have been on the subscription list.

Among this year's letters of "renewal" was one from one of our youngest, not our oldest subscribers, in which the writer, who, by securing a new subscriber, had earned our $2 premium, stated that the Scientific American was a Christmas present to his son, and requested that we comply with the boy's suggestion that copies of the Supplement be sent to him in lieu of the advertised premium. The letter proceeds: "When our son was nine years old, a copy of the Scientific American found its way to our house, and from that time he never let up on us until we subscribed for it for him. He is but fifteen years old; very fond of reading, and with a mind but for two studies, electricity and chemistry. We live in an isolated farmhouse, too far from schools, and the paper is one of his educators. He is very anxious to take the Supplement, but we feel as if we cannot afford to give it to him yet." It is needless to say that we were most pleased to accommodate our young Oregon subscriber.

The Tiffany Exhibit at the Paris Exposition.

In our issue of October 6, 1900, there was an illustration of the mineral exhibit of precious stones by this company. The fact that there was a still larger exhibit by the same company of the highest type of American jewelry, silverware, etc., in a special pavilion in the Liberal Arts was inadvertently omitted.

Electrical Notes.

The first regular meeting of the Roentgen Society of the United States opened December 13, in the Grand Central Palace, New York. About two hundred delegates were present, besides the members from New York.

The authorities in Paris have called the managers of the Underground Railway to account, and they have been fined for permitting the cars to be crowded beyond their seating capacity. The decision stated that American methods would not be allowed to prevail in Paris.

The French Telegraph Department proposes to institute a series of experiments with wireless telegraphy for subterranean communications. The possibility of the scheme was first suggested by one of the inspectors of the department, who found his primitive trials to give satisfaction. The department intends to develop the idea upon a larger scale.

Wireless telegraph stations are to be erected at Inishtrahull, in the north of Ireland, and at Kildonan, Arran, Scotland, respectively, for the purpose of reporting and signaling vessels at sea. Colonel Hozier, on behalf of Lloyds' committee, has informed the various Glasgow shipowners of the fact, and expects that the installation will be ready for service by the end of January.

The Adriatic Railway Company, of Italy, has decided to equip electrically two branches of the main line down the coast to Brindisi. These branches extend from the main line toward the interior, where the Apennines furnish abundant water power. In the highlands of Italy there is considerable water power which has never been utilized, and it is considered possible to use these falls for the generation of electrical power.

An electric arc lamp capable of taking a current of only three amperes will shortly be placed on the market. It measures seventeen inches in length, and weighs ten pounds. The carbon is only five-sixteenths of an inch in diameter. Hitherto the arc lamp has been utilized only in connection with great candle power, but the constant desire for a small lamp of this description for certain purposes, in place of the incandescent glow lamp which possesses many inherent defects, has resulted in the designing of this miniature arc lamp.

It is contemplated to construct a railroad, similar to the Jungfrau line, to the summit of Mont Blanc. M. Vallot, the Director of the Mont Blanc Observatory, and M. Deperet, Professor of Mineralogy at the Lyons University, in conjunction with M. Fabre, a French engineer, have been engaged for some time past in surveying the sides of the mountain to ascertain a suitable route and the atmospheric conditions. The result of these investigations is the projection of a line probably starting from the village of Houches, on the Savoy side, to the summit, to have a total length of eleven miles. Twelve stations specially constructed to resist the climatic conditions of the neighborhood will be provided. Electricity, to be obtained from the River Arve and the Mer de Glace, will provide the necessary motive power. The plans of the railroad have been presented to the French Minister of the Interior, and it is anticipated that the official permission will be granted, in which event operations will be commenced immediately.

An attempt is being made by several American capitalists to substitute an elaborate and complete system of electric traction, in place of horses, upon the canals of England. The country is extensively intersected by these water thoroughfares, and in the manufacturing districts, owing to freightage upon them being much cheaper than upon the railroads, they constitute the principal means of transit. Mr. Frank Hawley, the vice-president of the Traction Company, has also been surveying the canals of Holland, Belgium, and France, and has sought powers to introduce electric traction thereon. He has traversed over 3,000 miles of canals in all, and the concessions for this radical change have been granted in Belgium, where it is anticipated that the installation will be completed by next year. The whole of the plant is coming from this country. In England the scheme is only in an embryo stage; but in view of the great success which has attended the introduction of electric traction for other purposes, there appears every probability of the company receiving the necessary permission. The company guarantees an economy of 40 per cent in the cost of motive power. They will also sell power to manufacturers, and supply the neighborhoods through which the canals extend, with a cheap source of electric lighting. It is also explained that another advantage of the system will be that the position of any particular boat will always be known, so that the goods will not be lost sight of by the shipper from one end of the journey to the other. Under the present system of horse traction, owing to the location of the boat not being known, goods are often lost sight of for days.

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MANUFACTURE OF WATER-GAS AT THE FORTY-FOURTH STREET STATION, NEW YORK.—I.

The manufacture of coal gas was illustrated and described in our issue of October 6, 1900, the plant of the Consolidated Gas Company at Fourteenth Street being selected for illustration. The present article is devoted to a description of the manufacture of water-gas, as carried on by the same company in their plant at the foot of West Forty-fourth Street, in this city. Water-gas is a gaseous mixture which consists mainly of carbon monoxide and hydrogen. It is produced by forcing steam through a body of incandescent fuel. Although water-gas possesses great heating power, it is practically useless as an illuminant, and hence when it is manufactured, as in the present instance for lighting purposes, it has to be mixed with a certain proportion of illuminating gas before it is delivered to the city mains. Of our two front page engravings representing the Forty-fourth Street plant, the upper one shows the details of the plant for making pure water-gas, while the lower cut shows a complete plant for making illuminating water-gas; the last-named being known as the Lowe Apparatus.

ILLUMINATING WATER GAS.—A single element of the Lowe Apparatus, as shown in our illustration, consists of a generator a carbureter, a superheater, a condenser, and a scrubber, with the necessary boilers and blowers to supply, under pressure, the necessary steam and the air. The generator is a vertical shell 8 feet 6 inches in diameter and 16 feet high. It is lined with firebrick and at about a fourth of its height is a grate on which the fuel (coal and coke) is loaded to a depth of 7 feet. The cabureter is of the same dimensions as the generator and is also lined with firebrick, while the interior is filled with firebrick checkerwork. The superheater is 8 feet 6 inches in diameter by 20 feet in height, and like the carbureter it is lined with firebrick and filled with checkerwork. The generator and carbureter are provided with manholes at the top, while the superheater terminates in a stack valve as shown. Each of the three cylinders is provided with air inlets, with connection to a series of air mains, that are fed by a centrifugal blower. A series of pipes connecting the cylinders with one another facilitates the flow and control of the gases during the process. One air connection leads beneath the grate of the generator, another leads to the top of the carbureter above the checkerwork, and a third connection admits air below the checkerwork of the superheater. There is also a steam pipe which terminates in a jet below the grate of the generator; and by means of a pipe connecting with the oil supply, a spray of oil can be injected upon the top of the checkerwork in the carbureter.

In operation a supply of coal and coke fuel is loaded into the generator from a platform at the level of the top manhole, until it stands about 7 feet deep upon the grate. The stack valve of the superheater is opened, and the steam and oil supply are closed. Air is then blown through the fuel in the generator, the resulting products of conbustion passing through the checkerwork in the carbureter and superheater, and finally escaping through the open stack valve in the last-named element. The air, in blowing up through the fuel, combines with the carbon of the fuel to form carbon monoxide, which is conveyed from the top of the fuel through piping to the top of the carbureter. Here it meets a fresh supply of air from the air mains, and taking up more oxygen, forms carbonic acid gas. This combustion takes place as the gases pass down through the checkerwork. From the bottom of the carbureter the gases are led to the bottom of the superheater where, if it is necessary, a fresh supply of air is added to produce complete combustion. The gases then travel up through the checkerwork in the superheater, and finally escape through the stack valve. By the proper regulation of the air supply the combustion is rendered so complete that the gases as they pass to the stack are completely colorless. During the blow, which lasts about four minutes, the checkerwork in the carbureter and superheater is raised to a cherry red heat.

The various air valves and the stack valve are now closed, and steam is turned on below the grate of the generator. In passing up through the incandescent fuel the steam is decomposed into hydrogen and carbon monoxide. The oxygen in the steam combining with the carbon in the fuel forms carbon monoxide, and sets free the hydrogen, the gases as they pass from the top of the generator consisting chiefly of carbon monoxide and hydrogen, with a small amount (about 3½ per cent) of carbon dioxide, whose presence is due to the fact that a small amount of steam has not been thoroughly decomposed. This water-gas now passes to the top of the carbureter, where it is mixed with a spray of oil (naphtha or gas oil), which is forced in under a pressure of 70 pounds to the square inch. The mixture of water, gas and sprayed oil now travels through the checkerwork of the carbureter and the superheater, the heat of which transforms the mixture into a fixed gas whose average analysis, as shown by tests which are taken regularly at the works, is as follows:

Carbon dioxide	3.4
Illuminants	12.3
Oxygen	.5
Carbon monoxide	29.1
Hydrogen	30.3
Marsh-gas	21.3
Nitrogen	3.1

From the top of the superheater, the fixed gas now passes through the water of the seal-box, the object of the seal being to prevent any possible reversal of the flow of gas. From the sealed box the gas is led to the bottom of the scrubber, a vertical cylinder which is filled with a large number of superimposed wooden slats or gratings. A spray of water plays continually upon the top grating and trickles down through and over those beneath, thereby providing an exceedingly large wetted surface. As it passes up through the innumerable openings of the gratings the gas is cooled, and the heavy oils and pitch which it contains are condensed and deposited. The gas then passes between the tubes of a vertical condenser, consisting of a shell, containing a number of tubes through which cold water is constantly circulating, where it is cooled to the temperature of the atmosphere, the lowering of its temperature causing the condensation of any oils and pitch that may be left in the gas. The purified gas is now led to a relief holder, as shown in the illustrations.

The operation of blowing the air is known as the "blow," and that of blowing the steam as the "run." The run lasts about six minutes, at the end of which time the fuel and the checkerwork have been so far cooled that it is necessary to heat them again. To this end the steam and oil supply are shut off, the stack valve is opened, and the air blast is again turned on, as already described. The flow of steam, however, at the succeeding "run" is reversed by means of a reversing valve on the steam connections, the steam now being introduced at the top of the fuel and passing down through the same. The object of reversing is to keep the fuel at a more even temperature for if the "run" were all in one direction, say upwardly, the lower part of the bed of fuel would be comparatively cool and the top of the fuel excessively hot.

In the Lowe apparatus, as thus described, it is possible to vary the illuminating power of the gas by varying the amount of oil that is sprayed into the carbureter. The gas made at the Forty-fourth Street plant is of about twenty-eight candle power, and the capacity of the Lowe plant is 2,000,000 cubic feet per twenty-four hours.

STRAIGHT WATER-GAS PLANT.—In addition to the Lowe apparatus as above described, there is at the Forty-fourth Street station a complete plant for manufacturing non-illuminating water-gas. The product is conveyed direct to the relief holder, where it is mixed with the product of the Lowe apparatus, preparatory to being mixed with an oil gas that is prepared in a plant which will form the subject of an article in a later issue. The straight water-gas plant is a French system, which was introduced into this country in 1877, and was the first water-gas plant of any kind to be erected in this country. It consists of a generator, which is technically known as the "Gasogene," and a scrubber, as shown in the upper illustration on our front page. The gasogene consists of a rectangular shell, built up of wrought iron plates, which measures 6 feet by 12 feet by 14 feet high, and is lined throughout with firebrick. Two feet from the bottom is a grate for the coke and coal fuel, which is introduced through a charging door at the top of the furnace. Air is fed to the gasogene at two different levels, one set of pipes leading in below the grate, another at about the mid-height of the generator. There is also a steam connection at the bottom and one at the top. In the operation of blowing or heating up, the air supply at the bottom and at the center of the fuel is opened, the stack valve being left open, and the blow is continued for about five minutes, at the end of which time the fuel is heated to the proper temperature. The stack valve is then closed, the air supply shut off, and steam is turned on under the fuel bed, when the same reactions take place as were described in connection with the generator of the Lowe apparatus. The gases pass off from the top of the gasogene, through a seal-box, and down to the bottom of the scrubber, a large rectangular structure filled with a series of trays, at the top of which a spray of water is continually playing. As the gas passes up through the scrubber it is cooled and washed, the water serving to catch any dust or dirt which may have been carried over from the gasogene. The gas is here cooled down from about 180 degrees F. to 60 degrees F. From the top of the scrubber it is led to the relief holder, where it is mixed with the illuminating water-gas from the Lowe apparatus. The run lasts for about twenty minutes. After the steam has been blown up through the fuel for ten minutes, the valves are reversed and the steam is blown downward through the fuel for the next ten minutes, the object of the reversal being, as in the case of the Lowe apparatus, to maintain the fuel at an even temperature throughout its whole mass. The capacity of the gasogene plant is 8,000,000 cubic feet per twenty-four hours.

It will be seen that there is a radical point of difference between the gasogene and the Lowe apparatus, in the fact that, while the latter manufactures a finished illuminating gas, the former manufactures a simple water-gas without any illuminating qualities. The products of both plants being carried, as we have seen, to a common relief holder. From the relief holder the mixed gases are led to the condensers of an oil-gas plant, where they are mixed with the oil-gas, and the combined mixture is condensed, scrubbed, purified, and measured, and finally carried to a main holder of 2,000,000 cubic feet capacity, from which it is led to the city mains. This oil gas plant will form the subject of an illustrated article in a later issue.

Engineering Notes.

Two ice-breakers for Port Arthur are being constructed in a Finnish shipyard.

Shipments of pig iron from Alabama and Tennessee for the first eleven months of 1900 amounted to 1,200,000 tons.

One of the largest chimneys in New York State has just been completed for the power station of the Schenectady Locomotive Works. It is 200 feet high and 32 feet square at the base.

According to the Board of Trade returns for 1899, strikes in the commercial industries of Great Britain are appreciably decreasing. The aggregate duration of disputes for 1899 was 2,516,416 working days, compared with 15,289,478 working days in 1898. The latter heavy total, however, was due to the great strike in the engineering and marine industries. Compared with the average returns for other years, the figure for 1899 shows a decrease of 70 per cent, and is the lowest annual total yet recorded.

In view of the success that has attended the experiments with the ice-breaking steamer "Ermak" in forcing a navigable channel through the ice in the Baltic Sea, the Russian government have decided to construct several other similar vessels for the same purposes in other parts of the Russian Empire. It is stated that two of these vessels will be stationed in the East to keep the harbors of Russian Tartary open to navigation throughout the year, especially the harbor of Vladivostock, where it is proposed to lay down a number of new docks and to provide extensive wharf accommodation.

Experiments have been carried out on the Thames by the Thames Conservancy Board with the marine torch with conspicuous success. The tubes containing the calcium carbide ignited immediately the substance came into contact with the water, casting a brilliant light, which was visible for a considerable distance. There is every probability of this torch being requisitioned for the illumination of certain parts of the river by night for the guidance of vessels, etc. The existent illuminants are inadequate and very unsatisfactory, whereas the acetlyene gas sheds a glaring pure white light, covering a wide area.

The shipbuilding industry on the Clyde has received a decided stimulus during the past few months, and the output for November last year was the heaviest recorded during the past ten years. Twenty-three vessels were launched during the month, representing a tonnage of 67,693, as compared with 40,000 tons for the same month last year. For the first eleven months of last year 226 steamers were launched, aggregating 433,724 tons, as against 415,724 tons for the same period in 1899, an increase of 18,000 tons. Fresh orders are also being placed, including steamers for the Peninsular and Oriental, Union-Castle, and other steamship companies.

A meter for measuring the amount of steam which flows through a steam pipe has been introduced in Berlin by A. Friedeberg. It is described as follows: Inside a horizontal length of the main, a flap-plate, hung from a horizontal axis, actuates, through an internal sector and rack, a conical plug valve controlling an opening in the top of the main. When no steam is being used, the plate hangs vertically and keeps the valve closed; when steam is flowing through the main, it turns the plate more or less toward a horizontal position, thereby opening the valve correspondingly, and the steam escaping through the valve is condensed in a worm. The water from the worm is either collected in a measuring tank, provided with a gage-glass, or is delivered upon a bucket wheel, the revolutions of which are indicated upon a counter arranged to show the corresponding quantity of steam flowing along the main.

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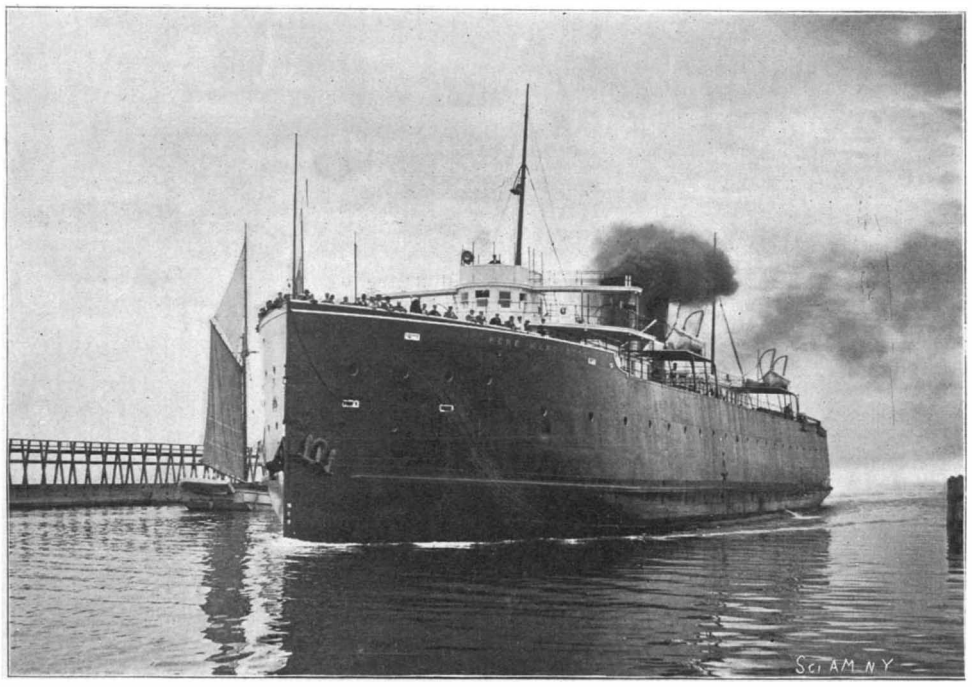
AMERICAN CAR FERRIES.

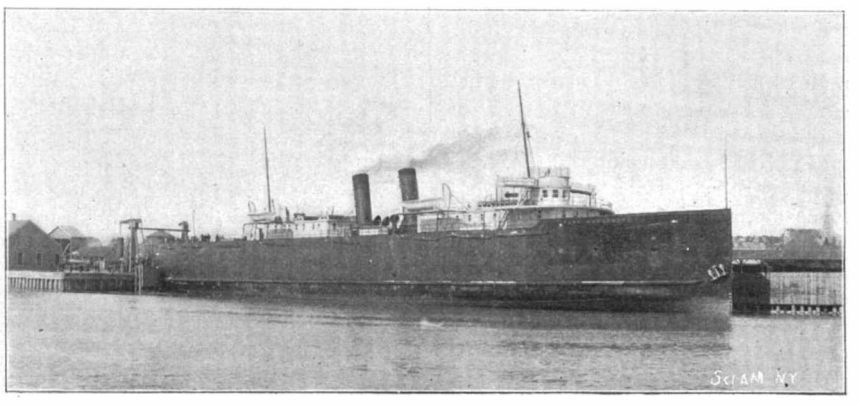
BY WALDON FAWCETT.

There would appear to be but small doubt that the car ferry, at least in anything approaching its present form, is an American invention, and certainly the process of development through which it has passed during the past few years has resulted in the evolution of a singular type of craft. Car ferries may, perhaps, be best described as connecting links in railway systems crossing stretches of water so expansive that to bridge them would be either impracticable or very costly. In appearance they are suggestive of the flat-bottomed boat, being somewhat "tub-like," in order that space may be provided on the main deck for the storage of the greatest possible number of railroad cars.

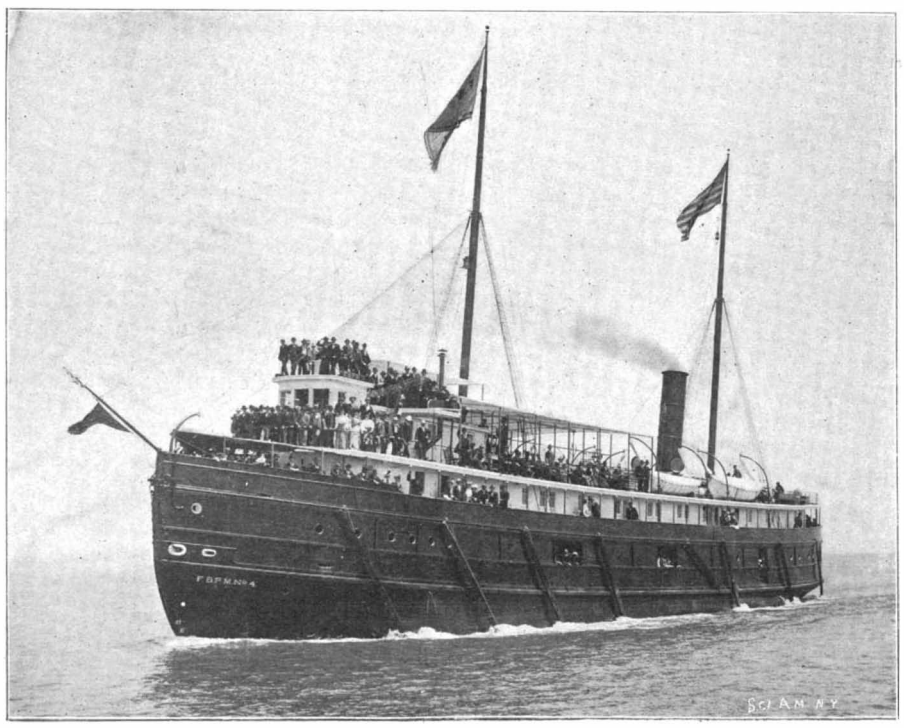
In size the car ferries in service in American waters range all the way from the small ferry steamers in service on some rivers, and which mayhap have not room for more than one or two cars, to the immense vessels built especially for this work which are in commission the year round on the Great Lakes and are capable of transporting at one time nearly three dozen loaded freight cars. The car ferries in the great fleet now in service in the United States include both steamers and barges or floats, which having no power of their own, must be towed either by tugs or car ferry steamers. Some of the vessels have only a single railroad track down the center of the deck, while others have four tracks abreast, each only a little short of 300 feet in length.



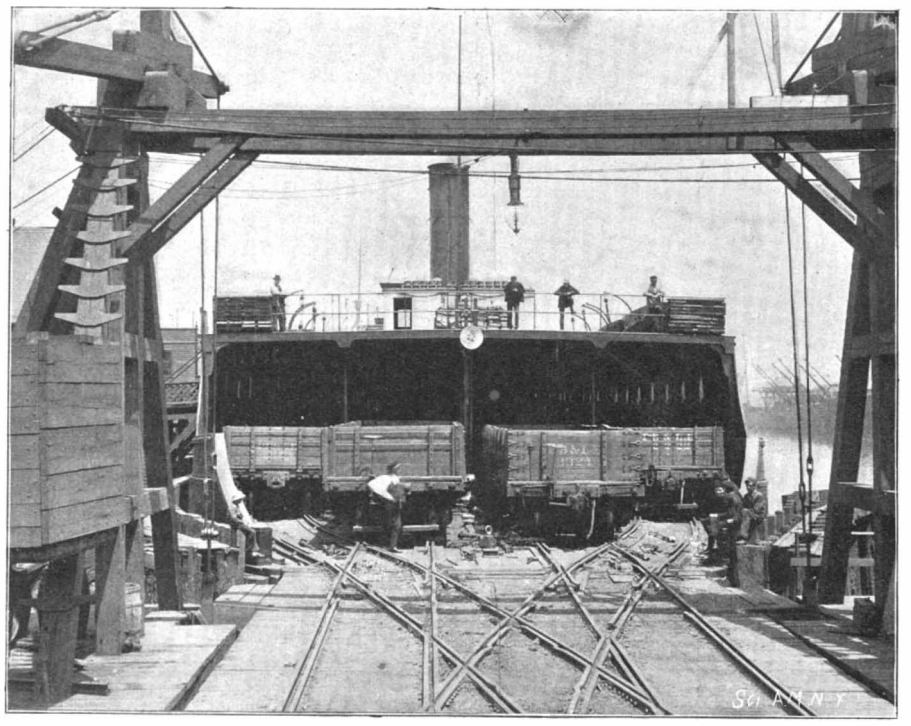
THE "PERE MARQUETTE."
Length, 350 feet; beam, 56 feet; depth, 36 feet; displacement, 4,200 tons; capacity, 30 loaded freight cars.



THE "PERE MARQUETTE" BACKED INTO HER LOADING SLIP.



AN "OLD TIMER."



LOADING CARS ON A FOUR-TRACK CAR FERRY.

The greatest interest attaches to the car ferries on the Great Lakes, not so much because they are the largest and most powerful in the country, as from the fact that they have been constructed especially for ice-breaking, in order that communication might be maintained throughout the winter on the frozen inland seas. They served as the models for the great ice-fighting steamers which the Czar's government has had constructed at great expense during the past few years in order to keep open some of the more important Russian ports, heretofore closed to navigation during many months of the year. The Russian engineers visited the Great Lakes in the dead of winter and studied the operation of the car ferries, and the Detroit naval architect, who designed most of the American vessels, was later summoned to St. Petersburg for purposes of consultation.

The car ferry of ice-crushing propensities is, it may be noted, a comparatively recent acquisition, even in this country. Until a decade and a half ago the railroads having termini at ports on the Great Lakes were dependent solely upon iron-shod ferry-boats. At some places, as for instance at Detroit, where the cars need be ferried only across a river with a fairly swift-running current, little difficulty was encountered by these vessels in keeping communication open, but farther north, at the Straits of Mackinaw and in other localities where there is a considerable expanse of open water, it was frequently found impossible to keep a path open through the ice fields, and the interruptions of freight and passenger traffic which resulted were both annoying and expensive to the railroad companies. The idea of the ice-breaking car ferry steamer, as at present constructed, was discovered purely by accident by a party of railroad officials and ship builders who stood, one day, watching one of the old-fashioned ferry-boats backing away from an ice-bound wharf. As the vessel made successive trips back and forth across the river, it was noted that she made her way against the ice better when going astern than when steaming forward in the usual way. To an engineer who was present this circumstance suggested grave possibilities, and he undertook experiments immediately thereafter, with the result that he discovered that a disrupting influence of considerable magnitude was exerted upon the ice by the disturbance of the water due to the rapid revolutions of the propeller wheel.

The outcome of the matter was the submission of a proposition for the construction of a car ferry steamer fitted with a screw propeller at each end. It was argued that, thus equipped, a vessel would not only have the requisite force to drive her forward at the speed required, but would also be provided with a weapon which could be used effectively against ice of great thickness. How meager, however, was the original conception of the magnitude of the project may be imagined from the fact that whereas $75,000 was the original estimate of the cost of such a vessel, it was found when it came to placing the contract that the expenditure would necessarily exceed $285,000.

Three of the principal railroads in Michigan made the construction of the vessel a joint project, and in 1888 the "St. Ignace," as she was called, went into service between Mackinaw City and St. Ignace, a distance of eight miles, and henceforth passenger and freight trains were transferred complete between these two ports. The "St. Ignace" was 235 feet in length, 52 feet beam, and of 1,200 tons burden. The slanting prow, which had been a distinctive characteristic of the old-fashioned car ferries, was retained in the new boat. It aided in the crushing, a work which was, of course, rendered all the easier by the action of the forward propeller in sucking the water from under the frozen field.

After half a dozen years of efficient service the "St. Ignace" was found to be incapable of accommodating the increasing railroad traffic, and there was constructed, at a cost of a third of a million dollars, that powerful ice-breaking ferry steamer the "Sainte Marie," which weighs upward of six million pounds and plows her way through ice several feet in thickness. The "Sainte Marie" is 305 feet in length and 53 feet beam. The hull below the water-line is of the heaviest oak construction, sheathed with quarter-inch steel, and the vessel is fitted with engines of 4,500 horse power.

Probably the most remarkable car ferry steamer on this continent, if not in the world, is the "Pere Marquette," which is operated between Ludington, Mich., and Manitowoc, Wis., and which has succeeded in keeping navigation open on her fifty-six-mile route across Lake Michigan during the severest winters of the past decade. This vessel is 350 feet in length, 56 feet in breadth, and 36 feet deep. She displaces over 4,000 tons on a draught of twelve feet, and her usual cargo consists of thirty loaded freight cars. When the "Pere Marquette" went into dry dock for repairs in the autumn of 1899, she had traveled more than 40,000 miles without any attention from the refitters, and when it is explained that much of this service had been at a speed of ten miles per hour through ice fourteen inches thick, some idea of the wonderful staunchness of the vessel may be gained.

It will doubtless surprise many readers to learn that officers of the Flint & Pere Marquette Railroad Company, which operates the vessel just described, are unanimous in the declaration that she does more satisfactory work in the intensely cold weather than when a milder temperature prevails. Very frequently in the dead of winter, when the thermometer ranges

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from eighteen to thirty-five degrees below zero, the ice in the path of the "Pere Marquette" varies from hard blue ice of a foot thickness to fifteen feet of snow ice where it has windrowed; and yet the vessel has never consumed more than forty-eight hours in making any one trip.

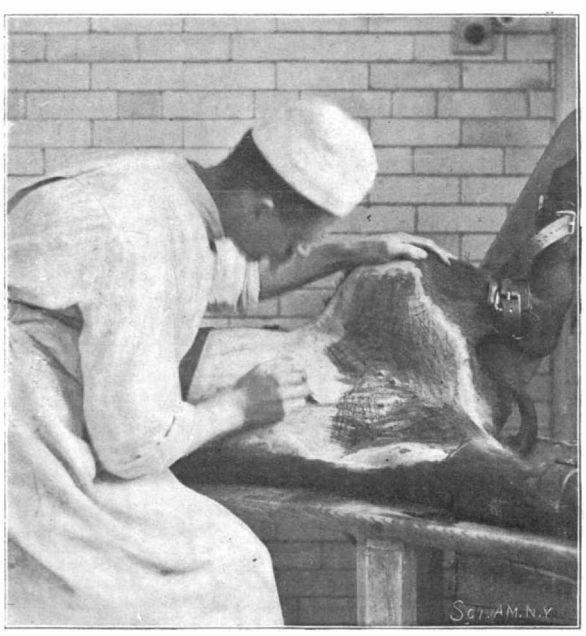
All of these car ferries are provided with the necessary jack-screws, chain, clamps, etc., for firmly securing the railroad cars; and the loading and unloading docks are equipped with a novel device corresponding to a giant gang-plank, which adjusts itself to the movement of the waves and thus enables cars to be transferred even though a heavy sea be running. There have been occasions in rough weather when cars have been loosened from their fastenings while in transit, and have collided with other cars, inflicting considerable damage; but, of course, these instances are rare.

Occasionally, too, the smaller and less powerful car ferries, such as those in service across Lake Erie from the American to the Canadian shore, become imprisoned in floating fields of ice, and a year or two ago the ferry steamer "Shenango" was thus imprisoned for nearly a month.

At almost every port on the Atlantic coast from Boston to the Chesapeake car-ferry steamers, of a distinctive American type, are in service transporting cars for comparatively short distances. Few of these boats, however, are capable of carrying more than a dozen cars, and in many cases the capacity does not reach that figure. Some of these vessels have cost as much as $200,000, so that it will be seen that a fleet of a dozen or more boats, such as some of the more important railroads operate, represents quite an investment. Car ferries are also in service at some points on the Ohio, Mississippi and other inland rivers; but they conform to the general type, except so far as they are of light draught, drawing in some instances only two or three feet of water.

VACCINE VIRUS—ITS PREPARATION AND ITS USE.

Variola or smallpox is said to have found its way into Europe in the seventh century, and to have been almost continuously present since. It was a permanent plague, against which no one was safe. Queen Mary, of England, and Louis XV., of France, both died of the disease. So widespread and deadly were the epidemics in the first three decades of the eighteenth century that seventy-four out of every thousand deaths were caused by smallpox. Helvetius, physician to the King of France, about 1723 referred in one of his works to the "almost unavoidable necessity of undergoing it at one time or another." The prevalence of the evil led English physicians to adopt the practice of inoculation with smallpox in 1721; but it was soon recognized that, although the individual thus treated usually suffered only a mild illness and escaped another attack of smallpox, the practice not only failed to reduce, but even multiplied the sources of contagion and thus indirectly increased the number of deaths. During the present century the frequency of the disease has decreased wonderfully. In the five years extending from 1893 to 1898 there were but one hundred and twenty-six deaths in all England and Wales; and from 1895 to 1899 there were but thirty-six deaths in the city of New York.

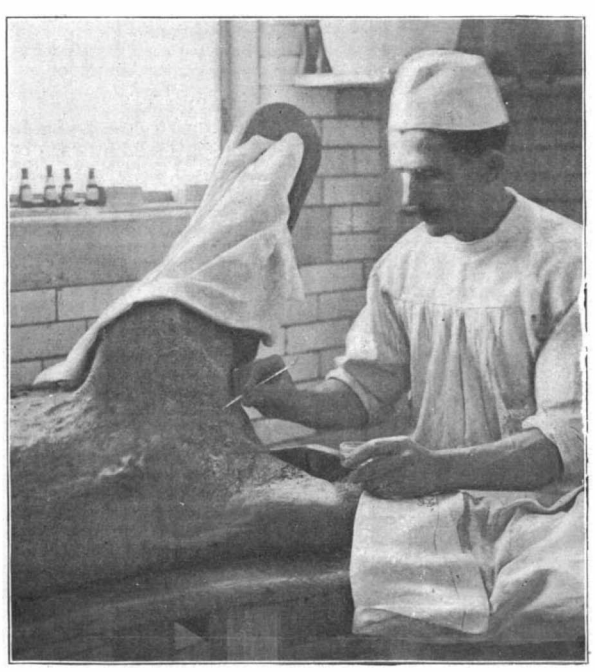


SCARIFYING A SHAVEN HEIFER.

bout 1768 a woman said in the hearing of Edward r: "I cannot take that disease, for I have had cowpox." It was a belief which, although common enough at the time, was held by most medical men to be based upon an imperfect induction from the facts. But Jenner, being a man of discernment and reflection, began a series of observations, and at last of actual experiment. On May 14, 1796, he inoculated an eight-year-old boy with matter taken from a vesicle in the hand of a dairy-maid smitten with cowpox. So perfect was this vaccination that the boy was inoculated with smallpox on the first of the following July without taking the disease. Two years later (1798) Jenner published his famous work, "An Enquiry Into the Causes and Effects of Variola Vaccinæ." In the following year vaccination was introduced in the London Smallpox Hospital; and in 1800 the practice was begun in this country through the efforts of Dr. Benjamin Waterhouse, of Cambridge, Mass.

GRINDING AND EMULSIFYING THE PULP.

In the early part of the century vaccination was effected almost entirely from arm to arm—a method which is largely followed in London to this very day But toward the middle of the century vaccine virus obtained directly from an animal began to be used in Italy. Although first regarded as the whim of an Italian physician, the custom of vaccinating with animal virus spread rapidly throughout Europe and the United States. In most European and a few American cities there have now been installed laboratories for the preparation and distribution of bovine virus. Many of the American laboratories have been patterned after the vaccine laboratory of the Health Department of New York. In order to show how vaccine is made, it is our purpose to describe in the present article the methods which are followed at this admirably-equipped New York laboratory.



COLLECTING THE PULP WITH THE CURETTE.

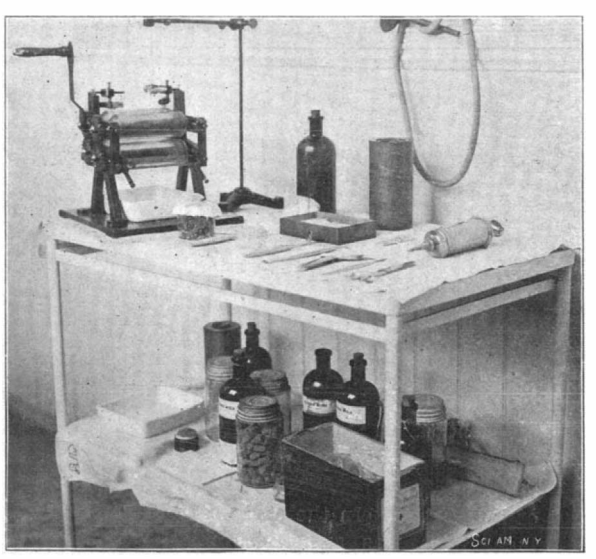
Until 1876 arm-to-arm vaccination was usually practised in New York, the lymph being taken only from a primary vaccination vesicle of a child a few months old and only on the eighth day. But human lymph has always been objectionable, in that it is a possible source of infection of a most serious blood disease. In 1876 the city Health Department started a vaccine farm, and out of this has grown the present vaccine laboratory. This laboratory at present occupies a three-story building of brick, the ground floor of which is divided into a stable, a receiving-room, an operating-room, and a sterlizing-room, and the second floor of which contains, besides laboratories for general bacteriological work, two preparing-rooms into which the virus is received after it has been collected in the operating-room.

The stable contains fourteen calf-stalls, having iron posts and side guards, revolving stanchions, and removable flooring. The operating-room resembles a hospital operating-room; it has a cement floor, enameled brick walls, and contains merely the operating furniture, a special table, enameled stools, wash-basins, and tables for instruments.

The preparing-rooms are provided with hydraulic pumps, each connected with two metal pipes used respectively for suction and blast. The free ends of these pipes are distributed along narrow benches at which the virus is drawn into capillary tubes, and the tubes hermetically sealed.

A calf before it is admitted to the stable is weighed, and its skin carefully examined. The body is curried and brushed; the feet are washed and scraped; and the hair is clipped from the tail. While at the laboratory the calf is fed exclusively on milk. Its condition is noted each day on a card hung beside its stall.

Placed beneath a window in the stable is a table of suitable form to which the calf is securely strapped. The posterior abdomen and inside of the thighs are washed with hot water and shaved—the first step in the preparation of vaccine. From the stable the calf is led to the operating-room and strapped on the operating-table. The shaved abdomen and thighs are again washed and then scarified with superficial linear incisions made with a surgeon's knife—a process which is not painful and entails but slight discomfort. The calf is now ready for inoculation. Into the bleeding incisions made by the knife, vaccine (cowpox) virus is carefully smeared with an ivory or metal instrument, after which the calf is returned to the stable. In a few days the entire scarified vaccinated surface is covered with vesicles, and from these the virus is obtained. On the sixth day the calf is led again to the operating-room and laid on the table. The area is most carefully cleansed. With a curette, a scoop-like instrument generally used by surgeons for digging out dead bone or morbid matter, the vesicles, technically called "pulp," are picked off, deposited in a small cup, and weighed. In the operating-room, and removed but a few feet from the table, a pulp-grinder is seated, whose duty it is to emulsify the collected matter. Before him is a small mill comprising four glass rollers superposed in pairs, geared together, and turned by a crank; and upon the rollers 60 per cent glycerine in water is allowed to drop from a burette such as every chemist uses in volumetric analysis. As it is ground in the mill the pulp is emulsified in the glycerine. The hard pulp collects on a scraper and is returned by the grinder to the top rollers in order to be



THE INSTRUMENT-TABLE.

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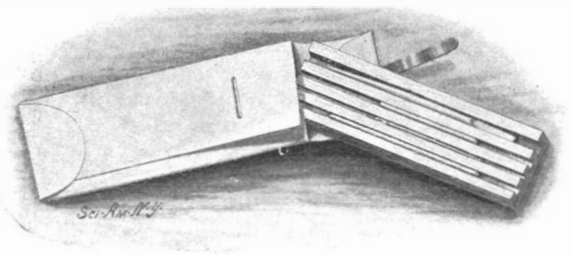
reground and further subjected to the action of the glycerine. The glycerinated virus from each calf is clinically tested in three insertions on each of five or more previously unvaccinated children. As a general rule 100 per cent insertion success is secured. During the tests, which extend over many days, the glycerinated virus is stored in large, hermetically-sealed tubes, properly labeled to insure identification. If the results are favorable, these tubes are taken to the preparing-room and emptied into small conical cups. From these cups the virus is drawn up into small capillary glass tubes, each tube containing enough virus for one vaccination. The ends of the tubes are then hermetically sealed with a blow-pipe. In order to ascertain whether this sealing is perfect, every tube is tested.

From the preparing-room, the filled and tested capillary tubes are taken to a packing-room, where each tube is inserted in one of the four grooves of a wooden holder shown in one of the illustrations. The other three grooves receive respectively a little rubber tube, a needle, and a small wooden spade resembling a toothpick. Thus charged, the wooden holder is slipped into an envelop on which directions for using the virus and the simple instruments by which it is accompanied are printed. According to these directions, the surface of the skin is to be scarified with the needle, the ends of the capillary tube are to be broken off, the small rubber is to be slipped over one broken end, and the virus is to be blown upon the wooden spade and thoroughly rubbed into the scarification. These printed envelops and their wooden holders are distributed by the Health Department to its various supply stations throughout the city and sold for ten cents each.

The theory of the action of vaccine on the human organism depends upon the relation of smallpox to cowpox. The novel elements of Jenner's discovery consisted not only in inoculating his patients with cowpox, but in boldly declaring that cowpox was "smallpox in the cow." For his temerity Jenner has been either sharply rapped over the knuckles by his contemporaries and by many modern physicians, or fulsomely praised as one of the most brilliant of investigators. Thousands of experiments have been made for the purpose of refuting or confirming Jenner's assertion; but even to this day the relation of cowpox to smallpox is almost as mysterious to us as it was to the physicians of Jenner's time. Inoculation of smallpox virus in the eighteenth century produced a disease which was extremely mild, and which frequently manifested itself by a single vesicle at the



THE HOLDER AND ITS ENVELOP.

PACKING THE WOODEN HOLDERS FOR DISTRIBUTION.

point of inoculation. In the early part of the century such inoculation was sometimes mistaken for vaccination. Smallpox, it is certain, can be modified; and if cowpox be merely a modified and attenuated form of smallpox, the protection which the former affords against the latter is comparable to the immunity conferred by many other infectious diseases which occur usually but once. Cowpox is an infectious disease which is found not only in milch cows, but in other animals as well. Jenner himself traced cowpox back to the "grease" found on horses' hocks; and "grease" was successfully used by Jenner and many continental physicians for vaccinating purposes. At the New York Health Department Vaccine Laboratory it has been shown that vaccine virus can be collected from horses, pigs, rabbits, monkeys, guinea-pigs, sheep, goats, and white rats; while attempts to inoculate the disease in dogs, cats, and mice have so far failed.

The duration of the immunity secured by vaccination varies considerably. Rarely does a single vaccination give immunity for life. Susceptibility returns between the seventh and tenth years, as a general rule. A second vaccination may, or may not, give immunity for the remaining period of life. Susceptibility may return again and again. But widely

FILLING THE CAPILLARY TUBES.

as the effects of vaccine inoculation may vary, it is certain that an attack of smallpox in a vaccinated person is generally milder than in the unvaccinated, and is rarely fatal. Failure of vaccination by active virus means merely that the person vaccinated is, at the time, immune, but tells absolutely nothing of the conditions which may prevail a few months later. Sometimes susceptibility to smallpox returns in a year after vaccination. Even an attack of smallpox itself, contrary to popular belief, does not always confer total immunity.

Athens Observatory.

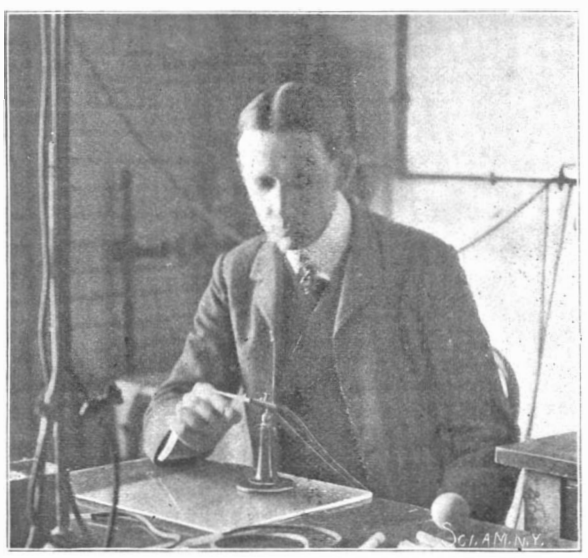
The Annals of the Observatory of Athens have been recently published in two volumes by M. Demetrius Eginitis, Director of the Observatory. This establishment was founded, 1843-1846, by the liberality of the Baron George Sinas, consul from Greece to Vienna. It has undergone many vicissitudes during the latter half of the century, and the regularity of the observations has been many times compromised by the events which have occurred in the peninsula. The Observatory was completely reorganized in 1890 and placed under the direction of M. Eginitis; since that time it has worked regularly and rendered great service to Greece and the neighboring regions by its meteorological and seismic observations. The result of this work is contained in the present volumes. The first of these contains a long study of the climate of Athens; the author has collected, verified and condensed the ancient observations and those of the last fifty years; the first fourteen chapters thus relate to the barometric pressure, temperature, winds, rain, etc., as well as optical phenomena (halos, rainbows, etc.), and to the temperature of the soil and sea. The portion of the work relating to observations proper includes a description of the meteorological instruments of the Observatory and of such observations made at Athens in 1894 and 1895. The second volume contains an important memoir upon the ancient observations of meteorite showers. The author finds that in the works of Nikephoros, Theophanes and Kedrinos, mention is made of three meteorite showers which he fixes at 752, 532 and 558 of the Christian era. The circumstances which accompanied these showers indicate that they belonged to the Bielides, and this hypothesis is confirmed by our knowledge of the periodicity of this group. But the different showers do not appear to have belonged to the same group of meteorites; those of 532 and 752 belong probably to the same fragment of the Biela comet, other than that which gave rise to the shower of 558, in the same way that the Bielides of 1798 and 1838 seem to belong to a group of corpuscles different from that producing the showers of 1872 and 1892. This confirms the idea of the author as to the slow disaggregation of the Biela comet. The second part of the volume contains observations upon meteorites, meteorological observations made at Athens in 1896 and those upon earthquakes made in Greece from 1893 to 1898.

Method of Recognizing Blood Spots.

One of the interesting points brought before the Congress of Medicine at Paris was a new method discovered by Dr. Ladislas Deutsch, of Budapest, by which the origin of blood-spots may be recognized; this will no doubt be of great value in legal decisions. Recent experiments have shown that if cells of a definite nature, such as the red globules of blood, are introduced into the organism of an animal the serum of this animal acquires the property of destroying these specific elements, becoming thus hemolytic, according to the term used. This solvent power is specific, and the author proposes to take advantage of it in the medico-legal diagnosis of blood-spots. This diagnosis has been one of the most difficult problems; the red globules of mammals could be separated from those of birds, but owing to the small variation in size those of the different mammals could scarcely be separated. With the use of hemolytic serums the diagnosis now becomes quite easy. It is only necessary to take up the stains with salt water (9 per cent) and add a few drops of the different serums. The serum which dissolves the most rapidly the globules in question, that is, in a few minutes, indicates exactly the origin of the globules. Thus, supposing that according to the testimony of the accused the spots come from a sheep, it only need be observed whether the corresponding serum for such globules dissolves it or not; if so, the origin is determined, if not the trial is continued by treating another portion with the serum for human globules, which is easily obtained by immunizing a laboratory animal (rabbit, guinea-pig, etc.) against these globules. This latter serum, by dissolving the globules of the spot in question, show clearly their human origin. This diagnosis is easily made and appears to be certain in its results. It is only necessary to be provided with the serums for most of the common animals and for human globules, and with a dozen or more serums it is easy to determine in most cases the origin of the blood-spots.

The Current Supplement.

The current SUPPLEMENT, No. 1307, is an unusually attractive number. "Electrical Illumination of the Pan-American Exposition" is accompanied by a number of engravings. "The Telegraphone" is by V. Poulsen. "Contemporary Electrical Science" has a number of short notes. "The Geological Society of America" is an abstract of the papers read at the meeting of the society, and is compiled by Edmund O. Hovey. "Recent Science" is by Prince Kropotkin. The usual Trade Notes and Receipts are also published. Prof. Robert H. Thurston's important paper upon the "Steam Turbine: Steam Engine of Maximum



SEALING THE CAPILLARY TUBES.

Simplicity and of the Highest Thermal Efficiency" is continued in this issue.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

CULTIVATOR AND HARROW.—MICHAEL SMITH, Asotin, Wash. This agricultural machine will act as a weed-exterminator, pulverizer, and cultivator. The machine has a series of frames coupled together so that they may yield. The frames are provided with vertically-adjustable caster-wheels, serving to regulate the depth to which the shovels enter the ground. An arrangement of shovels upon the various sections is provided, by which the ground is effectually cleared of weeds. The draft can be quickly shifted to the right or to the left to keep the implement straight, especially when work is to be performed upon a hillside.

Boilers and Furnaces.

ASH-PAN.—WILLIAM S. ANDERSON, Jasper, Tenn. The ash-pan is so made that it can be conveniently handled without fear of accidentally spilling its contents and without permitting dust and sparks to fly with the wind. The novel feature of the construction is a cover which is fitted with devices removably engaging the pan and by which the pan may be carried from one place to another and the cover disengaged when it is desired to empty the pan.

FURNACE.—JOHN L. PUSLIN, Chicago, Ill. On opposite sides of a combustion-chamber gas-flues are arranged. Independent fireboxes are provided for these gas-flues, which fireboxes open into the rear ends of the flues so that the products of combustion from the fireboxes pass into the gas-flues at the rear ends, in order then to travel forward and pass into the forward end of the combustion-chamber. A mixing device in the rear portion of the combustion-chamber serves the purpose of mixing the products of combustion from the gas-flues. Any kind of fuel or different kinds of fuel can be used. Cold air is prevented from striking the boiler when the charging-doors are opened for introducing fuel.

BOILER.—THOMAS P. CONNELLY, Jersey City, N. J. The boiler has a steam-compartment provided with a manhole in its top; a water-compartment; and tubes connecting the compartments with each other. These tubes are curved to permit their removal through the manhole. The bottom of the steam-compartment and the top of the water-compartment are dished toward each other; and the ends of the tubes extend approximately at right angles to the top and bottom. Baffle-plates deflect the smoke and gases. The boiler has a large heating-surface. The means for removing a defective boiler-tube without disturbing any of its neighbors are noteworthy.

PORTABLE STEAM-GENERATOR. — JOSEPH SCHOETTL AND CHRISTIAN JAEGER, Brooklyn, New York city. Through a boiler a vertically-disposed flue passes. A jacket incloses the boiler. At its lower edge the jacket has a skirt which projects below the boiler. From the upper part of the boiler a tube passes which serves the purpose of conducting away the steam. The tube extends downward between the boiler and the jacket and is coiled below the bottom of the boiler and then projected through the flue and beyond it. The generator is designed for the purpose of superheating steam for domestic uses. The inventor has shown in his patent one use to which his invention can be applied, namely, the cleaning of beer-pipes.

BOILER-FURNACE.—WILLIAM F. BEECHER, Cleveland, O. The gases arising from the fuel burning on the grate are mingled with air. In this manner perfect combustion is insured in the combustion-chamber, and the smoke consumed. The air which is fed to the gases has been previously heated, and is, therefore, in a proper condition to secure highly efficient combustion. Horizontal circulating-tubes are connected with the boiler, which tubes serve in a measure to protect the surfaces of the furnace-walls against the high heat of the combustion-gases.

Electrical Apparatus.

TELEGRAPH OR TELEPHONE CALL MECHANISM.—EDGAR E. SALISBURY, Chicago, Ill. This improvement in telegraph and telephone call devices comprises a simple mechanism for releasing the break-wheel on an upward movement of the receiver-supporting arm, and also for locking the arm in its upper position and releasing it after the rotation of the break-wheel. The winding and releasing of the call mechanism can be accomplished without removing the receiver or disturbing its supporting-arm.

Mechanical Devices.

TOBACCO-STEMMING MACHINE. — MILTON C. BAUGHAN, Barton Heights, Va. The body of the leaf is seized and held by one pair of belts, the runs of which are in close proximity, so that they may feed the body of the tobacco leaf lengthwise between them. Alongside this first pair of belts is a second pair of opposing belts, adapted to feed the stem lengthwise between them. In the operation of the machine under certain circumstances, the arrangement whereby the belts for carrying the body of the leaf are caused to diverge, operates to strip the stem from the body of the leaf without the necessity of employing separate stem-cutting devices. Nevertheless the inventor prefers to employ rotary cutters to sever the stems.

SCISSORS.—JONATHAN BADGER, Manhattan, New York city. The shanks of the scissors-blades are connected by a spring which acts as a handle and normally holds the blades apart or in a position to receive an object. The blades may be quickly brought into cutting action by pressing the end portions of the spring toward each other.

PIPE-WRENCH.—EDWIN F. COMBER, Selkirk, Manitoba, Canada. The pipe-wrench comprises a fixed jaw having an integral arm extending rearwardly, and a movable jaw pivoted on the fixed jaw. A cam-lever is fulcrumed on the arm and engages the movable jaw to swing it toward the fixed jaw. The cam-lever is operated by a handle. By means of this wrench a pipe can be firmly gripped. The jaws can be adjusted to accommodate pipes of different sizes.

MATRIX AND SPACE-BAND CLEANING MECHANISM FOR TYPE-SETTING MACHINES.—DAVID A. HENSLEY, Vicksburg, Miss. It is the purpose of this invention to provide means by which the type-matrices and space-bands will be automatically cleaned during their ordinary travel through the linotype. By thus keeping the matrix and space-bands clean the necessity of frequently renewing them is avoided. Opposing matrix-brushes are located in vertical alinement with the discharge-point of the matrix-belt, so that the matrices discharged from the belt will fall between the brushes and will thus be cleaned.

INTEREST-COMPUTING MACHINE.—LARS M. LANDING, Glenwood, Minn. Mr. Landing has invented an ingenious machine for computing interest and time. By its means an operator can readily figure the interest on various principals at various rates and for various times, and ascertain the time (number of days) between two given dates. The improved machine can also be used for solving, at least approximately, various other problems, such as finding the time during which the interest on a given principal will become equal to a given amount at a given rate.

BORING-MACHINE.—WILLIAM R. ABRAMS, Portland, Ore. To provide a machine for boring into wood without danger of clogging or breaking the tool is the purpose of this invention. The machine comprises a revoluble boring-tool having a hollow shank at the forward end of which a bit is carried. From the boring-tool a stationary discharge-pipe leads. In order to draw the chips or cuttings longitudinally through the tool and convey them away through the discharge-pipe a fluid-pressure pipe is used which creates the necessary suction. By the arrangement described the chips are removed from the bore as quickly as formed; and, consequently, there is no danger of the boring-tool's becoming clogged, or bent, or broken.

WASHING-MACHINE. — CALEB T. REEDER, Stewardson, Ill. The washing-machine has a plunger which creates a suction through the clothes so as to accelerate the process of washing them. The plunger works in a pan and carries a number or rigid strips, which serve as beaters for the clothes. The plunger, when forced downward upon the clothes, presses them against the bottom of the pan. Upon the return of the plunger, a suction is created which tends materially to assist in the process of cleaning the clothes. The plunger keeps the water in constant circulation.

HAT-SHAPING MACHINE.—MARI A. CUMING, Manhattan, New York city. On a steam-basin, a perforated die is placed. With this perforated die a movable die coacts to hold a hat. By reason of this coaction, the hat is subjected to the action of steam during the operation of the dies, to render the material sufficiently pliable to be readily molded or pressed. A crown-die is mounted to move toward and from the first two dies to form the crown of the hat. The first named dies have central openings through which the crown is enabled to pass.

SHAFT-BENDING MACHINE. — JAMES N. CHAPMAN, Memphis, Tenn. It is the purpose of the invention to provide a machine for bending carriage or buggy shafts of different lengths and thickness, and also for bending shaft-heels of different length and curvature, and at the same time to perform the work in less time than has usually been required for the purpose. By means of this machine two shafts are bent simultaneously; and the heels are formed on any required radius. The time required for bending a shaft is about one minute.

STAPLING DEVICE.—JOHN C. LARY, Clintonville, Ky. This device is used for the purpose of setting staples in position to be driven, especially in wire fence construction, and for fixing the staples in place without the possibility of injuring the hands or the fingers. The device carries a number of staples of any desired size, which staples are delivered one after the other to the fixing section of the device and automatically placed in position to be driven. The staples may be placed in any desired quantities on a magazine or collecting device, from which they are quickly transferred to the setting device in the field.

EXHIBITING DEVICE.—BERNHARD TROPP, Manhattan, New York city. This exhibiting device is to be used for advertising and for other purposes, and is provided with mechanism of improved construction by which a strip of material, carrying a series of advertisements or other matter to be exhibited successively, is moved intermittently in one direction and then caused to travel intermittently in the opposite direction. The interruptions or stoppages of the movement are long enough to permit the reading of advertisements.

Metallurgical Apparatus.

ORE-SEPARATOR. — AUGUSTUS C. HARTUNG, Galena, Kans. This separator is particularly adapted for the treatment of lead and zinc ores. The ore, mingled sand or ore, gangue and water are deposited upon a rotary table and spread out so that the heaviest material remains near the center. Canvas sweeps pack and spread the material evenly. An adjustable scraper takes up from the table different grades of material; and by the higher or lower adjustment of the scraper any desired quantity or grade of material can be removed and deposited in separate receptacles. Novel mechanism is provided to adapt the scraper thus to deliver into separate receptacles.

MACHINE FOR COLLECTING PRECIOUS METALS FROM RIVER-BEDS.—JAMES R. DAKE, Merrill, Wis. The machine comprises a frame in which a shaft is mounted. A current-pressure wheel is attached to the shaft, the wheel having laterally-swinging blades and being adapted to be entirely submerged. From the shaft an endless carrier is operated on which buckets are carried. The bucket-carrier is set in motion by the current-wheels. The buckets scoop up the sand containing gold or other metal and deposit it in the sluice. The water flowing through the sluice carries the sand and gold, the sand being discharged at the outer end of the sluice, while the gold settles in the pockets at the bottom of the sluice.

GOLD-GRADING AMALGAMATOR. — ALFONSO Z. BALDENEBRO, Mexico, Mexico. The object of the machine is to produce a current of pulp of uniform and constant velocity from the first receptacle to the last, and also to facilitate the deposit by gravity of the mineral particles at the bottom of each receptacle. Thus the heaviest particles are to be deposited in the first receptacle, the lightest or finest in the last. The current of pulp is passed through a gradually-increasing body of water as it travels from receptacle to receptacle. The agitation of the water is most violent in the first receptacle and least apparent in the last.

Railway Appliances.

FROG.—JAMES BARRY, Galveston, Texas. Situated at the outer sides of crossing rails are chairs or brace-blocks. U-bolts extend between the chairs and pass under the rails. A connecting-plate is fastened to the rails beneath the chairs and extends from one U-bolt to the other. It is claimed for this construction that it is more secure and durable than that at present employed.

GRAIN-DOOR. — JOSEPH E. BROWN AND HENRY H. WINTERS, Victoria, Kans. The object of the invention is to provide a door for freight-cars which is designed to prevent leakage of grain. A novel fastening is employed comprising cleat with an overhangi portion, the inner face of which is formed with transverse ribs for engagement by the grain-door to hold one end in place. The cleat is fastened rigidly to the railway-car at one side of the door-opening. A bar is arranged at the other side of the door-opening and has its lower end turned laterally to form a foot. A keeper is fastened on the floor of the car loosely to receive the foot of the bar. The upper end of the bar is drawn toward the car-body to clamp the grain-door between the bar and the car.

Vehicles and Their Accessories.

CART.—JOHN J. MCNULTY, Carmel, N. Y. This invention is a "jogging-cart" used for exercising horses, the object being to provide a light, strong vehicle and to give the driver the comfort which cannot be had in racing-sulkies. So light is the construction that the inventor has been able to produce a complete cart weighing not more than seventy-five pounds and yet capable of enduring all the strains to which it can possibly be subjected in ordinary use.

VEHICLE AXLE AND BOX.—JOHN G. ANDERSON, Rock Hill, S. C. To provide a new axle and box arranged to insure free circulation of the lubricant is the purpose of this invention. The axle has its spindle formed with a return oil-groove extending partly longitudinally on the top from the inner end toward the outer end. The outer portion of the groove turns downwardly and forwardly to the under side of the spindle. The box for the spindle has at its outer end an oil-chamber for the lubricant. The forward portion of the return groove opens into the bottom of the chamber.

VEHICLE-HUB.—EDWIN B. JONES, Hornellsville, N. Y. By means of this vehicle-hub the use of a spindle-bar or nut at the free end of the spindle is dispensed with. The vehicle-hub is detachably held on the spindle of the vehicle-axle. The connection of parts is dust-proof. The escape of lubricant is prevented; and the hub of the vehicle-wheel is held upon the axle-spindle in a manner which is both more simple and more efficient than that which has heretofore been known.

HAME-FASTENER.—SILAS T. MARLETTE, 27 Garner Avenue, Buffalo, N. Y. The hame-fastener is designed for quickly and securely connecting the lower ends of the hame sections about the collar with a tightening action, and is intended to be used in connection with any of the ordinary forms of hames. The hame-fastener is made in three parts. One of the end sections is made with a large, upturned hook, opening upwardly and containing locking devices. The middle section is formed with a concave seat fitting up against the lower convex side of the hook and co-operating with locking devices.

VEHICLE-REACH.—PETER S. WITHINGTON, Slack, Wyo. The improved reach rocks readily in the front axle, and allows a wheel to pass over an obstruction or to drop in a hole or rut without breaking or twisting the reach or coupling-pole. Either end of the vehicle may be tipped over without injuring the other end of the reach. The draft of the vehicle, moreover, is lightened, since there is no friction or binding on the reach. The axle is not weakened; because no hole is employed for a king-bolt.

Miscellaneous Inventions.

EARTH-AUGER. — WILLIAM B. GIBSON, Morrilton, Ark. The invention, briefly described, comprises a hollow cylindrical boring-head, in the bottom wall of which an inlet-opening is formed, closed by a gate. A scoop-like excavator-blade extends below the bottom of the head at one side of the opening. Teeth are projected from the bottom of the boring-head to loosen soil subsequently cut by the excavator-blade. For a diametrical enlargement of the hole bored by the excavator-blade, a counter-boring attachment is provided. A handle rod or bar is adapted to rotate the boring-head and also to open and close the gate. The counter-boring device is opened and closed from above the surface of the earth.

PROCESS OF WASHING GAS. — ICHARD E. PIPPIG AND OTTO F. TRACHMANN, Kiel, Germany. The present invention relates to a process for treating illuminating-gas obtained from coal, wood, peat, coke, or other similar substances with certain washing ingredients in such a way that gas escaping from leaks in the mains cannot injuriously affect vegetation. The process consists in extracting from the gas the vaporous substances (carbon bisulfid, carbonic oxysulfid, oil of mustard, mercaptane, thiophene, phenol, phenates, and the like), by means of washing ingredients among which are an amin capable of combining with bisulfid of carbon.

BOOK OR COPY HOLDER.—BURGESS T. MONTGOMERY, T'sr'y Dept., Washington, D. C. This invention is an improvement in holders or stands for books, loose sheets, documents, or the like, to be used by public speakers, copyists, and others. The holder is arranged to hold any of the articles mentioned of any reasonable thickness, and is so constructed that it can be adjusted to different elevations and inclinations and arranged for different articles as desired.

BINDING-STRIP FOR BOX-CORNERS.—WALLACE J. PIERRPONT, Savannah, Ga. The improved construction provides a box-corner strip the opposite edges of which are formed with alternating projections and recesses, the recesses and projections being of the same form, so that a number of the corner-strips can be cut from a plate of metal without any loss of material. The projections of one strip are formed in cutting the recesses of adjoining strips. The projections can be easily driven into any kind of wood without danger of splitting the wood. By forming the projections with the same angle on both edges they can be readily driven through veneer stuff in line with the grain; and the strip can thus be made of comparatively thin metal.

CURTAIN-FIXTURE.—JOHN B. BERNIER, Spencer, Mass. Mr. Bernier has devised a fixture for hanging shades and lace curtains, together or separately, and has so constructed his device that it can be very easily secured to or detached from the upper member of a window-frame of any transverse dimensions without using screws, nails, or like fastening devices which would lacerate a surface.

CALF OR COLT WEANER.—ALVY N. GOFF, Rocky Ford, Colo. By means of this appliance the calf or colt is prevented from sucking milk, but is permitted to graze, feed, and drink without interference. The appliance is attached to the animal's head so that it projects forward from the nose and yet, so that it will annoy the mother when the calf endeavors to take nourishment.

FIRE AND WATER PROOF REMOVABLE WALL, FLOOR, ETC.—JOHN MASSARO, Frankfort-on-the-Main, Germany. An iron floor-plate is used consisting of rows of upright plates set at convenient distances and provided with holes through which iron bars are drawn. The middle bars are vaulted to give strength to the floors. Upon these longitudinal bars cross-plates are tied up. The iron floor-plate is then brought in a mold of convenient size, filled up, covered with a layer of cement so that the floor-plates obtained bear on the iron as well as on the cement. The construction is fire and water proof.

WIRE-STRETCHER.—FRANK J. OLMSTED, Beaver City, Neb. The wire-stretcher has a lever adapted to be engaged with and to be

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moved around a post. In one of its edges the post has notches. A stretcher-head comprising a ring moves along the lever and is adapted to engage any one of the notches. A bar is arranged at right angles to the lever and has connection with the ring. Hook-bolts are mounted in the bar; and tightening-nuts are carried by the bolts. The device can be conveniently employed for stretching and twisting the ends of a broken wire.

ENVELOP.—JAMES A. ULLMAN, Manhattan, New York city. The purpose of this invention is to provide an envelop which can be opened very much more readily than the ordinary envelop. To this end an orifice is formed in the sealing-flap, through which orifice the blade of a knife may be inserted to cut the envelop open. In order to render the insertion of the knife-blade easy, a notch is cut in the back of the envelop just under the opening, so that the blade will have a clear passage into the interior of the envelop.

ADJUSTABLE DRESS-CHART.—HARRY C. WILSON, Manhattan, New York city. The inventor has devised a series of adjustable patterns which can be readily set according to measurements, so as to obtain proper patterns for ladies' waists. The principal aims of the invention are to simplify the adjusting operations, to provide a construction that will positively give the full outline of each piece, and to enable the dressmaker to vary the pattern.

BOTTLE.—WILLIAM A. FRIES, SR., Brooklyn, New York city. This invention relates to non-refillable bottles. Mr. Fries has been chiefly concerned with providing a bottle which is both practical and cheap and which is so constructed that the refilling of the bottle will be effectively prevented by means of a novel valve inserted in the neck. Many non-refillable bottles cannot be made by the ordinary methods of blowing and molding. The present invention, however, is primarily designed to overcome these difficulties of manufacture.

DRAWING AND MEASURING INSTRUMENT.—CELESTIA E. KERR, Decatur, Ga. The invention relates to an instrument for use in drawing, measuring, and working with various sorts of materials. The instrument comprises a scaled ruler, a T-square, a protractor, and a compass.

SILK-CLAMP.—JAMES J. MCGRATH, Brookhaven, Miss. The clamp is adapted to bind a bolt of silk and to retain the folds in proper position for exhibiting the goods. Main clamp-arms and auxiliary inner clamp-arms exert a clamping action at two distant points. The inner clamp-arms are of such form as to prevent them from making an impression on the silk when several bolts are superposed.

PIPE-ELBOW BRACE.—SAMUEL C. BROWNFIELD, Elmo, Mo. The pipe-elbow brace is formed in two sections adjustably connected, each section further comprising a clamp to engage the pipe, such clamps lying at angles to the sections so as properly to dispose the brace. By this construction a brace is provided which is adjustable to suit the form of the elbow.

TOOL-HANDLE.—ANTRIM L. WHITE, Springville, Iowa. Mr. White has provided a hammer or like tool to which a handle may be conveniently attached. Engaging the head is a metallic tube, into which a plug is forced to grip the interior walls, so that it is held in the head. A hand-piece is fastened to the outer end of the tube; the tube and the hand-piece jointly form the tool-handle.

TROUSERS-STRETCHER.—JOHN C. TATMAN, Victor, Colo. The trousers-stretcher consists of two cross-pieces, between which the legs of the trousers are clamped, and a central piece connecting the two cross-pieces. The central piece can be so adjusted that the cross-pieces are forced apart to stretch the trousers.

DISPLAY-STAND.—ISAAC STEINAU, Manhattan, New York city. The inventor has received both a mechanical patent and a design patent for a portable display-stand, which is intended to receive collar-buttons. The mechanical patent shows a bowl-body together with a transparent sectional cover for the body, the sections being capable of sliding one over the other. A stem serves to hold the parts of the cover loosely in position, and to prevent them from leaving the body. The design patent shows the bowl formed as a turned-down collar and the stem as a collar-button.

TACK-PULLER.—CHARLES A. EVANS, Haverhill, Mass. The tack-puller comprises a handled fork having spring arms, and a pair of spring-jaws fulcrumed between the arms and normally open. The spring-jaws are alranged to close by applying pressure and to open automatically upon removing the pressure, so that the tack pulled may drop out to permit the tool to be used again.

Designs.

VIOLIN-BRIDGE.—SAMUEL G. DONNELLY, Augusta, Ga. The leading feature of the design is an arched hook-shaped upper or head section of the bridge, which head-section at its left hand is connected by a shank with the base-section of the bridge.

BELT.—LOUIS SANDERS, Brooklyn, N. Y. The design provides an ornamentation resembling a collar located at the central or back portion of the belt.

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Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8026) W. H. T. asks: 1. Is the voltage of a circuit reduced by inserting resistance in series with the source of energy? A. No. 2. How is the voltmeter to be read—in series, or as a shunt with the resistance? A. The voltmeter is always connected as a shunt upon the circuit whose voltage is to be measured. 3. As I maintain the voltage is reduced, am I not right in saying: If the voltage is not reduced by passing the current through resistance, an unlimited number of lamps could be run, for in that case the amperage would not fall (by Ohm's law), therefore the current would remain constant, no matter what resistance was in the circuit? Suppose in a circuit carrying 5 amperes at a pressure of 500 volts, five 100-volt lamps are introduced in series; one lamp will take one-fifth of the pressure, while five lamps all, or 500 volts at 5 amperes? A. The resistance in a circuit has no control over the voltage. The drop between two sides of a circuit is the same, whatever the resistance may be. In a circuit with 500 volts pressure there is a drop of 500 volts between the positive and the negative side, under all circumstances. If across this there be put a wire with 500 ohms resistance, a current of 1 ampere will flow, according to Ohm's law, C equals E/R. If the wire have 100 ohms the current will be 5 amperes, etc., for any other resistance. Now, if you divide the wire into 500 equal parts, starting at the positive side, you will find a drop of one volt for each of the 500 divisions. This is just like going down a flight of 500 steps. You illustrate by the five 100-volt lamps across a circuit. Each of these lamps takes 100 volts drop in itself. The current for such a lamp is about one-half ampere. You cannot get five amperes through five such lamps in series. A current much in excess of a half ampere will burn the lamps out. The resistance of these lamps holds back the current, so that the lamp is not overheated. It is the increase of the resistance which produces the result which you ascribe to the reduction of the voltage, and in the usual direct current system the voltage is not affected by any other element of the current. 4. If this be so, what pressure and current are we going to get on the return (leaving out its resistance) to the dynamo? Will you kindly prove to me whether my statements are right or wrong? A. There must be enough pressure provided to force the current back to the dynamo. This is proportional to the resistance of the return wires. These wires are large and have a small resistance, hence but a few volts are needed to do this work. You must know that in every circuit a drop of voltage is provided for along the line, so that the lamps, motors, etc., get the proper voltage for their resistance, so that they may have amperes sufficient for their work. There are many people who think volts are the working factor of Ohm's law. On the contrary, amperes do the work: volts furnish the pressure to overcome the resistance. We get the expression very frequently: "A current of so many volts." The statement is entirely wrong. A current is measured in amperes, not in volts. Now the drop in voltage along the feeders, both in going from the dynamo to the lamps and the return from the lamps to the dynamo, is given to the circuit in excess of the voltage needed by the lamps. In a large system this excess is furnished by another generator, called a "booster," because it lifts the voltage enough to supply the loss due to the long line. If it were not for this the lamps remote from the station would not get their proper voltage and would not be properly lighted. 5. Also is there any explanation of the fact that when a voltmeter is placed in series with resistance, it reads practically the same voltage as when it is connected with the terminals of the dynamo? A. This statement is not true except when the resistance is so small as to be practically negligible as compared with the resistance of the voltmeter. A voltmeter is wound so that its resistance is enormously greater than that of any line to which it will be attached, so that it may consume but an insignificant fraction of the current. For a current of 110 volts pressure the voltmeter would have perhaps 10,000 to 15,000 ohms resistance. It would then take only about 1-150 ampere. The voltmeter indicates the drop of voltage between the points to which it is connected. If these are the poles of a dynamo, this is the whole voltage of the circuit; if there is a large resistance in series with the voltmeter, then the voltmeter will not indicate the entire voltage of the circuit. For illustration, suppose the added resistance were just equal to that of the voltmeter. The circuit now has a total resistance twice as great as that of the voltmeter; hence the drop of voltage through the voltmeter will be one-half and through the resistance it will be the other half of the voltage of the entire circuit.

(8027) C. P. says: I would be very thankful to you if you could only supply me with the following information, namely: What is the quantity of material that enters into the construction of a modern first-class battleship? Kindly give quantity in weight. You may also give exact dimensions. A. In such a battleship as the new "Pennsylvania," to be built for the United States navy, whose total weight is about 15,000 tons, 1,200 tons represents the weight of the guns and ammunition, etc.; 1,830 tons the motive power; 1,000 tons the weight of the boats, masts, anchors, chains, provisions, personal belongings of officers and crew, etc., leaving say from 5,000 to 5,500 tons as the weight of the hull. This ship is 435 feet long, 76 feet 10 inches in beam, and draws at greatest draught 26 feet; her freeboard above the water is about 20 feet.

(8028) B. O. asks how to give any article made of copper the appearance of old bronze. A. You can treat your copper article with the following:

Vinegar	1 quart.
Ammonia chloride	250 grains.
Common salt	250 grains.
Liquid ammonia	½ ounce.

The salts are first dissolved in the vinegar, and ammonia is added to the solution when it is ready for use. Small articles may be immersed in the solution, then removed, and when one part becomes too dry a paint brush is drawn over it so as to keep all parts uniform. The color should be carefully and uniformly spread. When the copper has taken the desired tint and the liquid begins to dry and to thicken, the wet parts should be dried with another brush having long bristles or hairs, and when this is too wet to use, another is applied, and so on till the whole is dry. The article is then allowed to rest in a warm place till the next day, when a second coating is given in the same manner as the first. The color now assumes a deep tone, and it may be necessary to repeat the operation several times to get a desired shade. After allowing the article to remain twenty-four hours after imparting the last coat, it is finished by well brushing with a soft brush which has been rubbed on a cake of white wax.

(8029) H. B. asks for a little help concerning the formula for the "Toning of Bromide Prints," found on page 408 of the SCIENTIFIC AMERICAN of December 29, 1900. 1. How shall I make the solution of "neutral citrate of potassium?" If, on mixing, it is found to be either acid or alkaline, what shall I add to neutralize it? A. You may be able to purchase neutral citrate of potassium. Test the solution with red or blue litmus paper. If it changes the color slightly from red to blue, the solution is neutral. If it changes it to blue, the solution is alkaline, and may be made neutral by adding citric acid. If solution turns blue litmus paper red, it is too acid, and may be neutralized by adding a solution of potassium carbonate. 2. Further, it says: "Add the sulphate to the citrate, *mix*, and add the ferricyanide," etc. Does this mean to add the sulphate to the citrate before they are in solution, or after? A. All. After.

(8030) S. D. H. writes: In one or two of his articles Mr. Hopkins speaks of tinning the ends of metals so that they may be more easily soldered. How is this operation performed? Also, will you kindly give me directions for making a flux or soldering solution to be used in soldering copper, brass, tin, iron, etc.? A. To tin copper, for making electrical connections, scrape the surface, or clean it with a piece of fine sandpaper, rub it over with pulverized rosin, and apply solder with a hot soldering-iron. Rosin is a good flux for joints between copper, copper and brass, and copper or brass and tinned iron. A flux for iron or steel is made as follows: Dissolve zinc in hydrochloric acid until it will take no more. Add an equal quantity of water. As the fumes of the acid and gas are very corrosive and pungent, this solution should be made in the open air. After a joint is made with the aid of this solution it should be thoroughly washed to prevent corrosion. It should not be used on fine copper wires.

NEW BOOKS, ETC.

OTTAWA, CAPITAL OF THE DOMINION OF CANADA. Ottawa: The Ottawa Free Press. 1899. 4to. Pp. 79. Price 50 cents.

A charming little booklet filled with interesting views of Canada's capital. It is profusely illustrated, and no feature of the city is omitted. An excellent map shows the water powers near Ottawa.

ANNUAL REPORT OF THE STATE GEOLOGIST FOR THE YEAR 1899. Geological Survey of New Jersey. 8vo. Pp. 327.

The admirable reports of the State of New Jersey are very valuable. The forests of the State have been considered as coming within the limits of the investigations and surveys of the Geological Survey, consequently a considerable part of the report is given up to forest matters.

A MANUAL OF ASSAYING. By Alfred Stanley Miller. New York: John Wiley & Sons. 1900. 12mo. Pp. 91. Price $1.

The student is taught his subject by easy grades. The book appears to be a good elementary treatise.

STUDIES, SCIENTIFIC AND SOCIAL. By Alfred Russel Wallace. Two volumes. London and New York: The Macmillan Company. 1900. 12mo. Pp. 532 and 535. Price $5.

These volumes will charm all who are interested in science. Space forbids to give even an outline of the chapters. The first section is devoted to "Earth Studies," with six chapters, then comes "Descriptive Zoology," "Plant Distribution," "Animal Distribution," "Theory of Evolution," "Anthropology," "Special Problems," "Educational," "Political," "The Land Problem," "Ethical" and "Sociological." The essays appeared in the leading reviews of the world. The versatility of the thoroughly trained scientist is admirably displayed in these volumes.

BOTANY. An Elementary Text-Book for Schools. By L. H. Bailey. New York: The Macmillan Company. 1900. 12mo. Pp. 355. Price $1.10.

A most admirable text-book. The author seems to have a great gift for book-making. Botany can be easily made a very dreary subject, but not with the aid of such books as these. The illustrations are very fine and are numerous. Persons desiring to obtain an elementary knowledge of botany would do well to buy this book.

ELECTRIC WIRING TABLES. By W. Perren Maycock, M. I. E. E. London: Whittaker & Company. New York: The Macmillan Company. 1900. 24mo. Pp. 144. Price $1.50.

The book can be carried in the vest-pocket, and for this reason will be found very useful. It is chiefly intended for those engaged in electric light wiring and fitting, but will be found generally serviceable to electrical engineers. The tables while fine are clearly printed.

THE HUMAN FRAME AND THE LAWS OF HEALTH. By Drs. Rebmann and Seiler. Translated from the German by F. W. Kieble, M. A. London: J. M. Dent & Company. New York: The Macmillan Company. 1900. 16mo. Pp. 147. Price 40 cents.

Three people have collaborated to bring forth this little vest-pocket book. The subject seems to be well treated within the rather severe limitations.

THINGS A BOY SHOULD KNOW ABOUT ELECTRICITY. By Thomas M. St. John, Met. E. New York: The Author. 1900. 12mo. Pp. 179. Price $1.

Many of the time-honored cuts make their appearance as usual. The author deals more with the uses of electricity than with experiments.

CONTRIBUTIONS TO PHOTOGRAPHIC OPTICS. By Otto Lummer. Translated and augmented by Silvanus P. Thompson. London: Macmillan & Company. New York: The Macmillan Company. 1900. 8vo. Pp. 139. Price $1.90.

A splendid treatise on the subject by a physicist of note and translated by another of equally great fame. All who are interested in photographic optics should possess a copy of this book, which will certainly prove a standard treatise on the subject.

PLANT LIFE AND STRUCTURE. By Dr. E. Dennert. London: J. M. Dent & Company. New York: The Macmillan Company. 1900. 18mo. Pp. 115. Price 40 cents.

A volume of the "Temple Primers." Many of the essentials of botany are interestingly told. It would make a good introduction to the science.

CHEMICAL TECHNOLOGY; or, Chemistry in its Applications to Arts and Manufactures. Vol. III., Gas Lighting. By Charles Hunt. Philadelphia: P. Blakiston's Sons & Company. 1900. 8vo. Pp. 312. Price $3.50.

The third volume of Grove's and Thorp's well-known book has been written by an English gas engineer. It deals with the subject in a very thorough manner, and the latest phases of the subject are dealt with. While

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of course English practice is described, gas making is very much the same in both England and America. The book is finely illustrated.

THE COMPLETE COST-KEEPER. By Horace Lucian Arnold. New York: The Engineering Magazine. 1900. 8vo. Pp. 408. Price $5.

Many a large plant has been wrecked by inattention to such matters as cost-keeping, and the present volume ought to be welcomed by all but the hide-bound, as it contains some original systems of shop cost-keeping which are extremely valuable. Cards are advocated, and wherever they are introduced they are sure to save money and minimize labor. It is an admirable book.

FURNACE HEATING. By William G. Snow. New York: David Williams Company. 1900. 8vo. Pp. 170. Price $1.50.

"A furnace consists essentially of a stove within a casing. Air is admitted to the space between the two, where it becomes heated, rises and flows through the pipes to the various rooms." From this lucid definition the author deals with the whole subject in a very practical manner, illustrating his text freely. We cannot recommend any better treatise on the subject.

TREATISE ON MATHEMATICAL AND GRAPHICAL ROOF FRAMING FOR BUILDERS AND CARPENTERS. By G. D. Inskip. Philadelphia: F. Weber & Company. 1900. 12mo. Pp. 160.

TREATISE ON MATHEMATICAL AND GRAPHICAL ROOF FRAMING FOR BUILDERS, CARPENTERS, ETC. By G. D. Inskip. Philadelphia: F. Weber & Company. 1900. Two vols. Narrow 8vo. Pp. 327. Price $3.50.

This work is designed to lessen the difficulty of angular complication as in roof framing, etc., where the hypotenuse of a right-angle triangle is essential. The systems now in vogue among the laymen are of an intricate nature, and the student is apt to get discouraged with the multiplicity of the lines used to obtain the result. The author's system is intended to minimize the troubles of the ordinary system. By means of the tables of reductions and squares and the table of angular ratios almost any problem can be readily solved. The book is very handy in form and can be slipped in the pocket of the workman. The text in the first volume is accompanied by a large number of diagrams showing how to work out the most intricate problems. It is a most excellent series of books.

THE PRACTICAL ENGINEER POCKET-BOOK FOR 1901. Manchester, England: The Technical Publishing Company, Ltd. 1901. 24mo. Pp. 462. Leather, gilt edge. Price $1.

We called attention in our review of the last issue of this manual to the remarkably cheap and satisfactory book which has been provided by the publishers of The Practical Engineer. The present volume is no exception to those which have gone before. Many additional tables have been inserted, and several sections have been rewritten. The book compares favorably with some engineer's pocket-books which cost more than three times the amount.

STUDIES IN FOSSIL BOTANY. By Dunkinfield, Henry Scott Lord. London: Adam & Charles Black. New York: The Macmillan Company. 1900. 12mo. Pp. 533. Price $2.75.

Fossil botany is a most fascinating subject. The author's purpose has been to present to the botanical readers those results of palæntological inquiry which appear to be of fundamental importance from the botanist's point of view. He has succeeded in making an excellent hand-book.

WILSON'S PHOTOGRAPHIC MOSAICS FOR 1901. Edited by Ed. L. Wilson. New York: The Editor. 1901. 16mo. Pp. 176. Price 75 cents.

For thirty-seven successive years "Mosaics" have been published, and each issue has been anxiously awaited by many old friends. The present volume has many excellent examples of fine portraiture, and the literary contents are fully up to the average.

A RECORD OF BOOKS LOANED FROM THE LIBRARY. Boston: Current History Company. 1900. Price 25 cents.

An excellent idea is for everyone to register the books which they loan. It will often save a book when there is any contention as to ownership.

INDEX OF INVENTIONS

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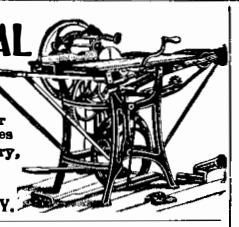

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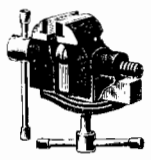

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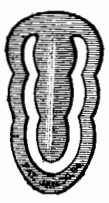

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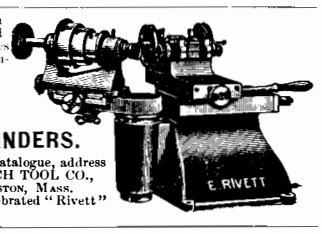

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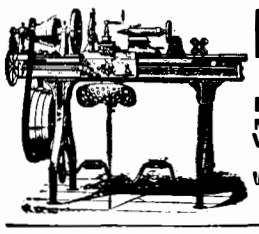

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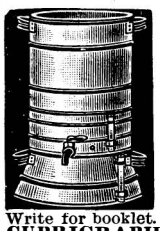

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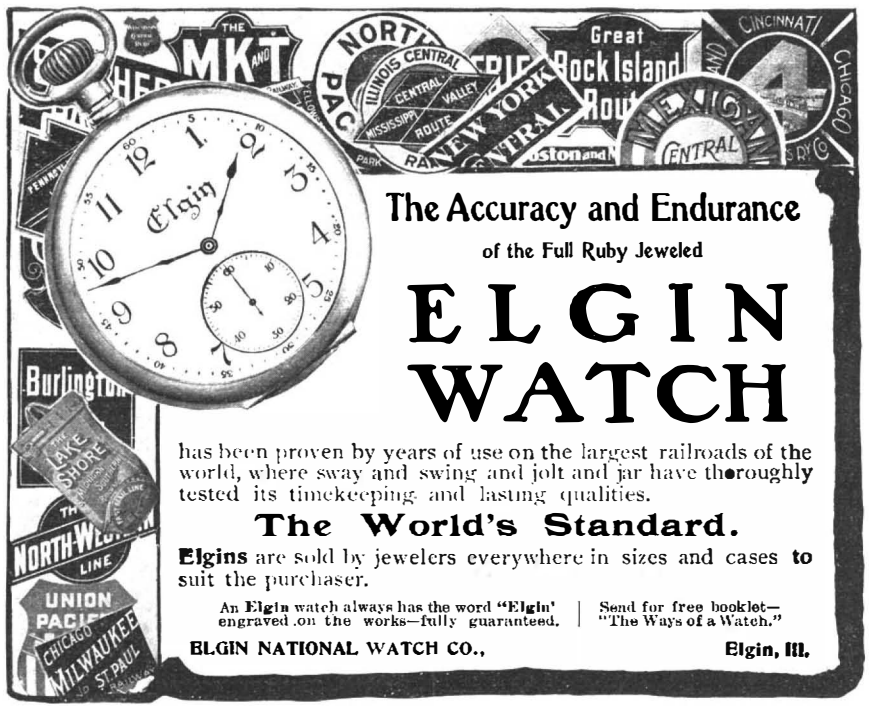

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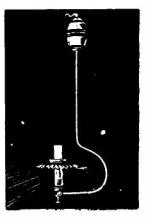

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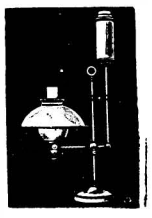

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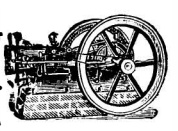

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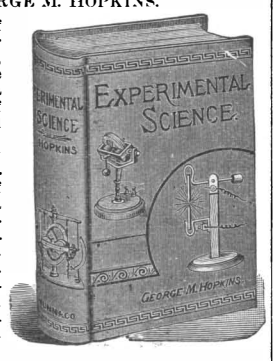

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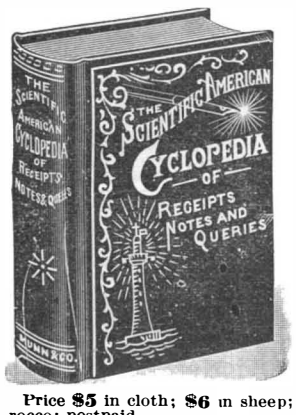

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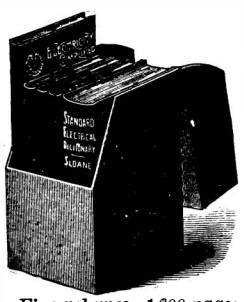

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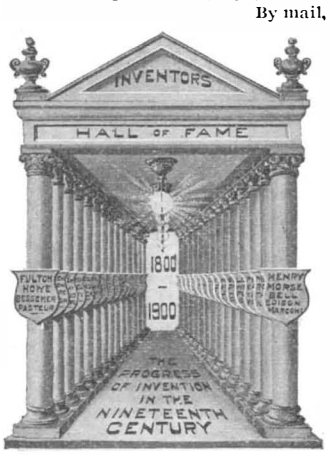

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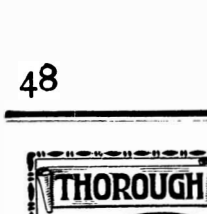

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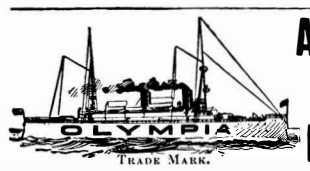

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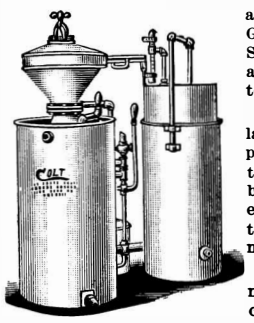

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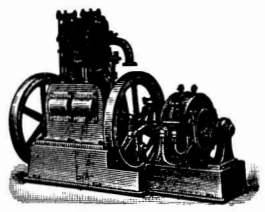

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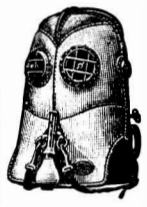

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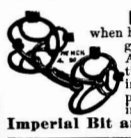

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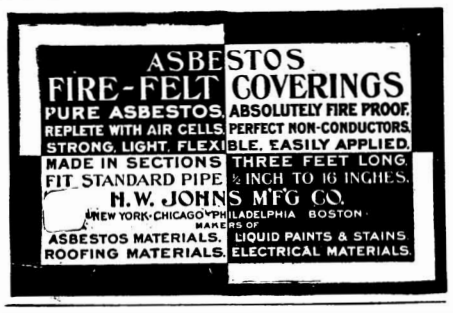
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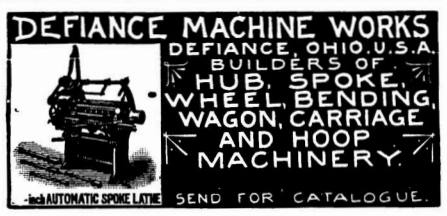

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